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THE EAST MIDLAND GEOGRAPHER

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No. 12 DECEMBER 1959

EDITORIAL NOTE

On behalf of our subscribers and all who regularly read *The East Midland Geographer,* we offer to Mr. E. M. Rawstron our warmest congratulations on his appointment to a Readership in Geography at Queen Mary College in the University of London. Since its inception in 1954 Mr. Rawstron has shouldered the main task of producing each issue of this periodical and his resignation leaves a gap which will be difficult to fill. In expressing our thanks to him we wish him every success and happiness in his new post.

THE GEOMORPHOLOGY OF THE AREA AROUND MELTON MOWBRAY

K. M. CLAYTON

This account of the landforms of the area around Melton Mowbray is offered as an introduction to a very varied and interesting region. It is a preliminary survey that may stimulate more detailed investigation. This is a part of the Jurassic scarplands of England and many of the relief elements found elsewhere on the Jurassic rocks are found here, but their arrangement is much more complicated than over much of the East Midlands. Thus the relief of the area is quite different from that of the scarp and vale country of Lincolnshire to the north(1), and the dissected plateaus of Northamptonshire to the south.

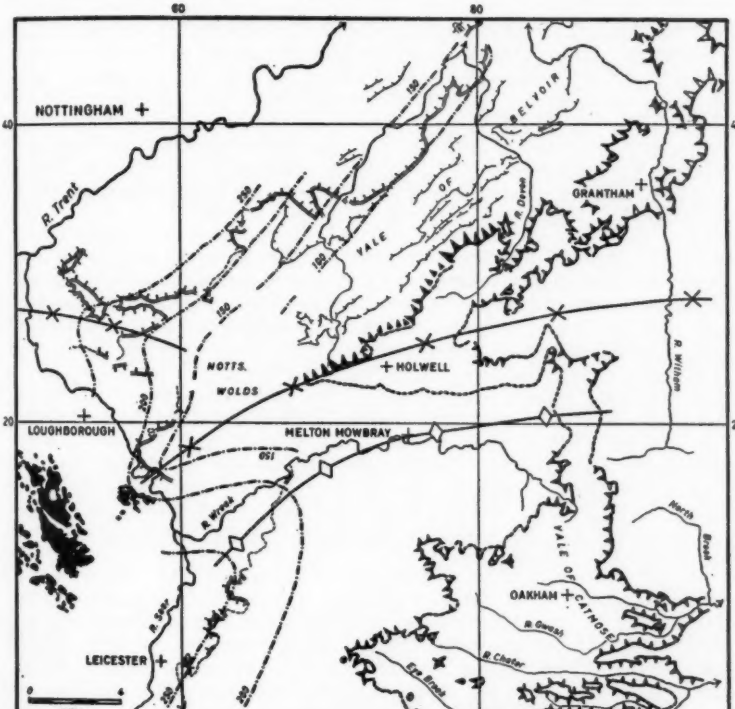

Fig. 1
Major morphological features

Basically these differences are caused by small east-north-east to west-south-west folds, an anticline and an associated syncline. These folds were briefly noted by P. E. Kent[2] in an article concerned with east-west folding of Jurassic age that affects the thickness of the strata in this area. Kent did not name the pitching folds that affect the present structure, but he suggested that they were of Tertiary age. He named the east-west Jurassic folds the Melton Mowbray anticline and the Waltham syncline[3]; it is suggested here that the Tertiary folds shown on Figure 1 should be called the Holwell syncline and the Wreak anticline. It is clear from the literature[4] that considerable confusion has been caused by the close juxtaposition of these folds of different dates, particularly as the pronounced westward swing of the outcrops of the Lower Jurassic rocks is partly due to the Waltham syncline, which gives an increase in the thickness of the beds, and partly due to the Holwell syncline.

In Figure 1 structural contours on the Rhaetic show the folds at their maximum amplitude before they are lost to the west in the Keuper Marl outcrop. To the east, up the pitch, the folds decrease in intensity until they die out completely east of the Witham. Of the two folds, the syncline to the north is the more important. The anticline to the south is quite closely followed by the River Wreak. A subsidiary downfold is suggested by the structural contours on the Rhaetic (Fig. 1) and it is possible that this continues westwards to the Rhaetic outliers in Needwood Forest, 30 miles to the west.

The Jurassic rocks outcropping in the area are summarised in Table I. The main features of this local succession are the unusual thickness of the Marlstone (it is thickest just north of Melton Mowbray and thins both to the north and to the south) and the importance of both the Lincolnshire Limestone and the Northampton Sands and Ironstone within the Inferior Oolite. To the north of the synclinal axis the Lincolnshire Limestone is the more important but to the south the Northampton Sand becomes the main scarp former within the Inferior Oolite. The clays of the Upper and Lower Lias are frequently obscured by considerable thicknesses of glacial drift, so that although clay vales are found, they are not continuous along the strike of the rocks. These thick deposits of boulder clay are not restricted to the clay outcrops, but also mask the scarps of the more resistant beds in some places.

TABLE I

Great Oolite	*limestone*	15 feet
Upper Estuarine Beds	*shales*	30
Inferior Oolite		
Lincolnshire Limestone	*limestone*	100
Lower Estuarine Series	*clays*	15—20
Northampton Sand	*sandstone and ironstone*	25
Upper Lias	*shales and clays*	120
Middle Lias		
Marlstone	*sandstone and ironstone*	to 40
M. Lias clays	*shales and clays*	100
Lower Lias	*shales with thin limestones*	650
Rhaetic	*shales with limestone*	30
Keuper Marl	*silty clays*	630

The most important effect of the Holwell syncline is the pronounced westward swing of the scarp of the Marlstone. This runs westward from Belvoir Castle along the south side of the Vale of Belvoir. The change in direction is associated with a gradual thickening of the Marlstone Rock Bed, but the change of the direction of dip along the north side of the Holwell syncline is a more important cause. The simple relationship of the plan of the scarp to the fold is obscured by the failure of the scarp to reappear on the south side of the fold where the junction is completely obscured by boulder clay. However, the Marlstone reappears south of the Wreak, on the south side of the complementary Wreak anticline, and can be traced from Leesthorpe Hill to Burrough Hill. From there the scarp resumes the general southerly trend characteristic of the Jurassic scarplands in the East Midlands.

As the folds die out eastwards the Inferior Oolite scarps do not diverge from their north-south alignment as much as the Marlstone, but there is an appreciable westward trend of the Lincolnshire Limestone feature south of Grantham. The Lincolnshire Limestone outcrop is also buried by drift south of the Holwell syncline and by the time it reappears near Market Overton is trending due north-south, suggesting that the Wreak anticline dies out more rapidly eastwards than does the Holwell syncline to the north. The north-south scarp, south of the folds and east of the Vale of Catmose, is formed by the Northampton Sand. The Lincolnshire Limestone is still important in this area, and its outcrop is shown on the Stamford sheet (157) of the Geological Survey. As is very clearly shown by the section on that sheet, it completely fails to make a feature for several miles, being planed off by an erosion surface at about 450 feet. This is the best preserved erosion surface in the Melton Mowbray area.

It will be seen that the relief in this area is inverted ; the ridge between the Vale of Belvoir and the Wreak is synclinal, while the Wreak has inverted the anticline to the south. In addition, the high ground south of the Wreak is gently synclinal in character, with low dips, but a tendency to convergence from the north and the south. This youthfully dissected area, with the unusually high altitude of 755 feet at Whatborough Hill, is a very individual piece of countryside. Basically it is a high plateau on the backslope of the Marlstone, deeply cut by streams falling to the Vale of Catmose to the east. Scattered on the back-slope, and rising above the general plateau level on the west and accordant with it on the east, are outliers of the Inferior Oolite capping concave slopes on Upper Lias clay. Whatborough Hill is the highest of these outliers ; and Robin-a-Tiptoe reaches 726 feet, while Colborough Hill, just over 700 feet, consists entirely of Upper Lias and has only recently lost its Inferior Oolite capping. These isolated remnants of the Inferior Oolite have no doubt survived here because t has long been a water parting.

The streams draining the back-slope of the Marlstone are closely spaced, and they flow in roughly parallel courses eastwards or east-south-eastwards. In the south these streams continue across the Upper Lias Clay outcrop and through the Inferior Oolite scarp by separate water-gaps. The ridges between the streams are narrow, but high, and carry long tongues of the Inferior Oolite so that there is no Upper Lias Clay vale. In contrast the northern part of the Upper Lias outcrop here

forms the Vale of Catmose, opened up by headward extension of the Wreak which has captured the eastward-flowing streams. This must have occurred before the last glaciation of the area (the main Older Drift glaciation) for the wind-gaps cut by these streams through the Inferior Oolite scarp east of the Vale of Catmose are completely plugged by boulder clay (Fig. 2).

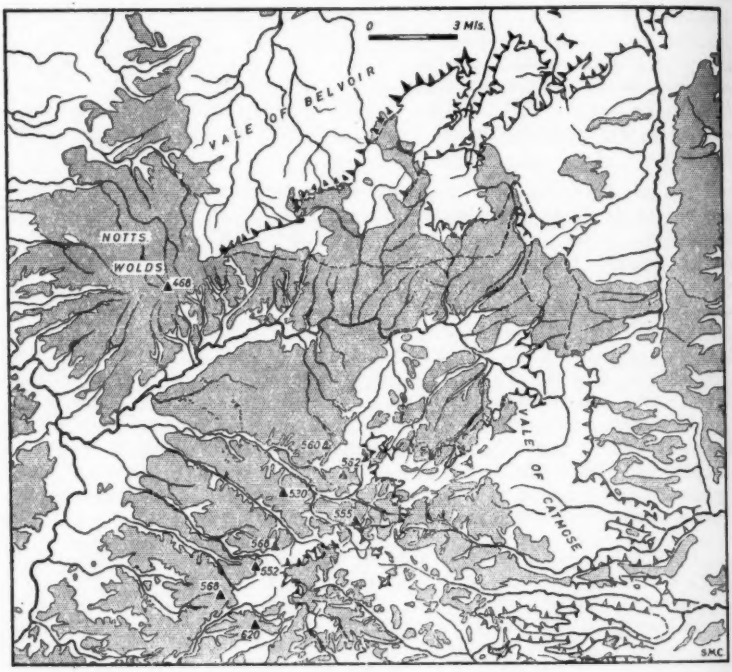

Fig. 2

Drift map

Scarps of Marlstone and Inferior Oolite shown as in Fig. 1. Boulder Clay is stippled.

There is some evidence of an erosion surface a little above 600 feet to the west of Oakham. Considerable areas of the Marlstone and also many of the more easterly of the outliers of the Inferior Oolite rise to this level. As has been shown, the drainage of this area suggests a relatively recent origin as a series of consequent streams, and it may be that this 600 foot surface is of marine origin. Such a hypothesis is suggested by the description of a marine surface, with similar superimposed drainage, in the Mansfield Plateaueast of the Pennines([5]), and further north where Sissons has called it the Brierley surface([6]). However, whether this particular feature is of marine or subaerial origin, the evidence of its low eastward slope suggests that it is quite separate from the lower surface at about 450 feet already described from the eastern side of the Vale of Catmose. This interpretation conflicts with the hypothesis put forward by Kellaway and Taylor([7]) that the landforms of both the Oakham area and the Jurassic outcrop to the south have

evolved from the dissection of a single, tilted summit surface. They called this surface the 'East Midlands erosion surface' and suggested that as the streams on it showed some adjustment to structure, it was of sub-aerial origin. This is not the place to examine their argument in detail, but it does seem that none of the evidence they bring forward would conflict with the alternative hypothesis that the 'summit surface' is a polycyclic feature composed of a stairway of surfaces of different ages and possibly of different origins. This is not to say, at this stage, that a polycyclic origin is the more likely, but it is equally consistent with their evidence. It seems to be favoured by the field evidence from the Oakham area, but more detailed work is needed to substantiate this.

The other upland of the Melton Mowbray region, between the Wreak and the Vale of Belvoir, has a composite origin. The eastern part is built of Jurassic rocks, the Marlstone escarpment from Belvoir Castle to near Old Dalby and the Lincolnshire Limestone escarpment to the south, with its westernmost point near Waltham on the Wolds. In places drift-filled valleys cross this upland from north to south and two mapped by the Geological Survey profoundly affect the form of the Marlstone scarp at Clawson Hill and Stathern. The drift floor seems to lie below the level of the base of the Marlstone Rock Bed at these points as the drift plugs tend to form irregular promontories beyond the main scarp. A third drift-filled valley is suggested by the boulder clay outline on the Old Series map, and field mapping confirmed that this breaches the Lincolnshire Limestone scarp near Croxton Kerrial (Fig. 2). It enters the Devon valley which continues through the Marlstone scarp to the north. Some of the drainage off the boulder clay sinks on reaching the Lincolnshire Limestone in a swallet at 840276.

In the absence of bore-hole information it is impossible to be more precise about the floor levels of these plugged windgaps, and there is no direct evidence of the direction in which the former streams were flowing. However, the probable presence at one time of the River Trent only a short distance north of the present Marlstone scarp south of the Vale of Belvoir, together with the higher ground to the south of the Wreak valley suggests that these are former right-bank tributaries of the Trent, or of some other west-east stream flowing through the Ancaster Gap. The capture of these streams must have taken place when the Wreak succeeded in inverting the Wreak anticline.

The western continuation of the upland north of Melton Mowbray, the Nottinghamshire Wolds, is built entirely of glacial deposits. As the radial drainage suggests, this is a huge, conical pile of boulder clay, accumulated on the western end of the Marlstone escarpment (Fig. 2); it is eight miles in diameter and near Six Hills reaches a height of 468 feet. The presence of this vast quantity of drift immediately south of the almost drift-free Vale of Belvoir is at first sight very curious. Presumably the considerable thicknesses of boulder clay south of the Vale accumulated around or in the lee of the various obstacles lying across the direction of movement of the ice-sheet. The pile forming the Wolds is the result of the westward projection of the Marlstone feature along the Holwell syncline. The thick drift on the south side of the synclinal Marlstone ridge represents accumulation in the lee of the high ground, rather like the 'tail' of the crag and tail features found in Central Scotland.

Another area where the drift deposits are thick and form the present landscape lies west of the Burrough Hill—Tilton section of the Marlstone escarpment. Here is a sub-maturely dissected landscape of boulder clay, a number of parallel ridges separated by the valleys of closely-spaced streams that flow west-north-westwards to the Soar or Wreak (Fig. 2). As in the case of the Wolds, the direction of drainage and the slope shown by the upper surface of the boulder clay coincide; the present drainage arose on the newly-deposited drift. This recent origin accounts for the lack of integration of these streams; so far few of them have succeeded in enlarging their basins by capture. No doubt this has also been aided by the very considerable initial slope of about 50 feet per mile of the boulder clay surface, which will have led to rapid incision of the new streams and so discouraged capture. The upper limit of this sheet of boulder clay is clearly defined; each ridge rises eastwards to reach a maximum altitude, usually at about 550 feet. There is then a pronounced col before the foot of the Marlstone scarp is reached. It is conceivable that this col could be an original ice-marginal feature, a sort of gutter lying between the ice and the Marlstone. However it is thought to be more likely that the feature has formed since the ice melted, and that it has resulted from the divergent retreat of the upper edge of the boulder clay and the Marlstone scarp.

It must again be said that this is a provisional account of a complicated area. The fundamental problem that needs further investigation is the origin of the East Midlands erosion surface, and a detailed field study of the morphology of the area should produce evidence on this problem. The other problems are largely concerned with the glaciation of the area, the detailed reconstruction of the pre-glacial drainage and the post-glacial evolution of the areas covered by thick boulder clay.

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(2) Kent, P. E., 1937, The Melton Mowbray Anticline, *Geol. Mag.*, 74, p. 154.
(3) This superseded the Old Dalby syncline of Cox, A. H. and A. E. Trueman, 1920, Intra-Jurassic movements and the underground structure of the southern Midlands, *Geol. Mag.*, 57, p. 198. P. E. Kent suggested that their Old Dalby syncline could be confused with the fold here called the Holwell syncline.
(4) See Rastall, R. H., 1927, The underground structure of Eastern England, *Geol. Mag.*, 64, p. 10. and Cox and Trueman *op. cit.*, p. 198.
(5) Greenhalgh, A., 1950, The geomorphology of the Mansfield Plateau, Unpublished dissertation, University of Nottingham.
(6) Sissons, J. B., 1954, The erosion surfaces and drainage systems of south-west Yorkshire, *Proc. Yorks. Geol. Soc.*, 29.
(7) Kellaway, G. A. and J. H. Taylor, 1953, Early stages in the physiographic evolution of a portion of the East Midlands, *Quart. Journ. Geol. Soc.*, 108, p. 343.

THE LEICESTERSHIRE AND SOUTH DERBYSHIRE COALFIELD

(2) The Clay Industry

W. D. HOLMES

After coal-mining the clay industry is the second basic industry in the Leicestershire and South Derbyshire coalfield. Employing 12 per cent of the insured population it is the largest of the secondary industries(1), and 40 out of approximately 100 manufacturing firms are engaged in it. The Western Basin of the coalfield, in which the bulk of the clay industry is concentrated (Fig. 1), contains some of the finest fireclays and pipe clays in the country, and in recent years its annual production of salt-glazed pipe-ware has amounted to over 25 per cent of the total output of the United Kingdom.

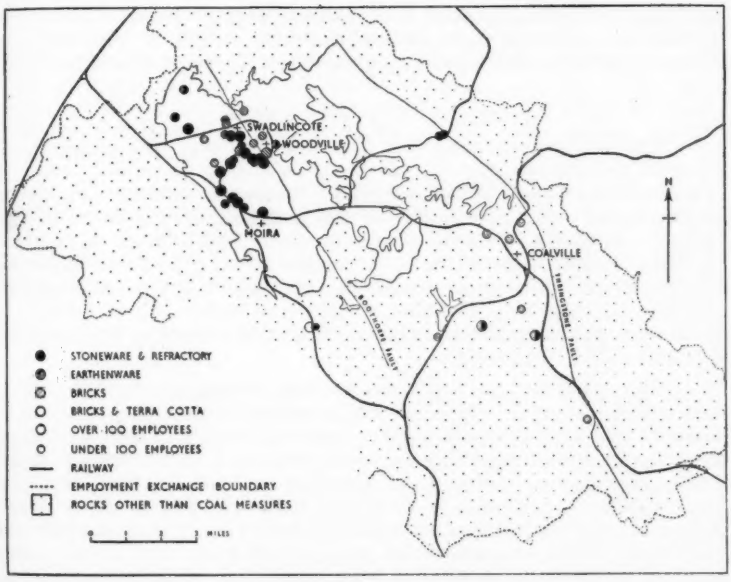

Fig. 1
Clay industries on the coalfield

EARLY GROWTH OF THE CLAY INDUSTRY

Pottery making began in 1790 in Church Gresley, Swadlincote and Hartshorne(2), and by 1830 several additional firms were established. At least four of these early concerns are still operating. In the early nineteenth century production consisted mainly of earthenware utensils,

(1) *East Midland Geographer*, No. 10, Dec. 1958, p.18.
(2) L. Jewitt, *Ceramic art of Great Britain*, London, 1878, Vol. 2, pp. 158, 159, 161

such as pancheons; Rockingham ware; refractory materials for the iron industry; and bricks and terra-cotta ware, like drain-pipes and tiles. The earthenware products were sold throughout the United Kingdom and exported, via Burton and the Trent-Mersey Canal, as far afield as the West Indies and America(1).

The growth of the industry in the first instance was due to the existence of coal and suitable clays—both heavy and bulky commodities—in the same place. During the nineteenth century two further factors favoured a rapid expansion of the industry: the need throughout the country for improved sanitation, and the building of the railways. New standards of sanitation led to the production of salt-glazed sanitary pipes, and later of other types of sanitary ware. These articles are large and heavy; for example, a 40-inch diameter sanitary pipe weighs approximately one ton per yard; and the industry could not have expanded without the aid of railway transport. The Coalville-Burton line was completed in 1849 and provided a timely link with wider markets, but the opening of the Woodville loop in 1844 seems to have more nearly coincided with the expansion of the sanitary ware industry. This loop gave several of the existing works access to the Burton line and encouraged the establishment of others nearby. Between 1880 and 1890 six new firms were established alongside this line (Fig. 1).

Present Types of Product

The present production of the industry may be classified, in accordance with the type of clay body used, into refractory products, stoneware, earthenware, and bricks and terra-cotta ware. Refractories include a wide variety of such products as firebricks, kiln bottoms, flue linings and boiler seatings, which range in quality from the highest grade of crucible material for steel furnaces to stove backs for domestic fireplaces. They are made from fireclays, which are seatearths with a comparatively high alumina content and a minimum amount of fluxes such as iron oxides and sulphides, able to withstand temperatures of about 1750°C. before fusing.

The stoneware products are mainly salt-glazed sanitary pipes and fittings, a small number of multiple-duct cable pipes, some other types of sanitary ware, and a little domestic pottery. The pipes range in diameter from 3 to 48 inches and include a vast variety of bends, traps, channels, syphons, and junction pipes(2). They must be impermeable(3), resistant to corrosive material, smooth to facilitate flow, and of great physical strength to support surface movement and buildings. These characteristics are derived from the use of a clay which vitrifies during firing, and from a salt-glaze which is imparted to the pipes by burning salt on the kiln fires during the later stages of firing. The vitrifiable pipe clays are seatearths with the high silica content needed for salt-glazing, a high proportion of fluxes to induce vitrification at a much lower temperature (1100°C.—1300°C.) than

(1) E. Mammat, *Geological facts and practical observations of the Ashby Coalfield*, London, 1836, p. 72.

(2) The catalogue of the Salt Glazed Pipe Manufacturers Association lists no less than 1,400 varieties of junction pipe alone.

(3) The B.S.S. for sanitary pipes stipulates a porosity of less than 6% for pipes up to $\frac{3}{4}$ in. thick.

the fireclays, and sufficient plasticity to permit the pipes to be moulded and extruded whilst retaining enough green strength to maintain their shape during drying and when stacked in the kilns.

The remaining sanitary stoneware consists of basins, closets and urinal stones. These are much heavier than earthenware varieties, and, possessing many of the properties of vitrified pipes, will withstand a great deal of weathering and hard usage. They are not salt-glazed but burn to the natural cane colour of the clays used, although they may be covered with a white earthenware engobe before firing. The domestic pottery includes preserve jars, bulb bowls, and hot-water bottles.

Earthenware, unlike stoneware, is not vitrified. It is lighter, less robust, and porous, and in order to render it impermeable it must be glazed and fired a second time. The earthenware group includes sanitary ware (almost entirely closets), art and domestic pottery, and electrical insulators. The raw materials for making the earthenware are now imported into the region and consist of cane firing siliceous clays, more plastic than pipe clays, and white burning clays. The use of cane firing clays for both stoneware and earthenware products leads to some confusion of terminology. The so-called "pottery clays" of the coalfield, formerly used for earthenware, are the local cane firing clays at present used for stoneware : the better clays are now exhausted and those remaining are unsuitable for the higher quality earthenware of today.

Clay products of the fourth group—bricks and terra-cotta ware—are made from fusible clays obtained mainly from the Keuper Marl rocks and to a lesser extent from the Coal Measure seatearths. Bricks made from the former are usually high quality facing bricks which are sold in markets as far apart as Scotland and south-eastern England. The seatearths are used mainly for commons. Terra-cotta, which is unglazed porous pottery, includes such products as land drains, roofing tiles and chimney pots.

The nature of the clay-ware production is illustrated in Figures 1 and 2(1). Most firms manufacture more than one type of product,and the proportions of these vary from year to year in accordance with fluctuating demand. For example, pipes and refractories are usually made by the same firms which also make common bricks when necessary ; sanitary ware may be manufactured in stoneware and earthenware in the same factory. Pottery firms, however, with one minor exception, confine themselves to domestic earthenware, often specializing in one type of product such as Cornish kitchen ware, mixing bowls, butter coolers, or art pottery. Over the coalfield as a whole stoneware and refractories predominate, 26 out of 42 clayworks producing these articles ; 12 firms manufature earthenware(2), and 9 are engaged in brick-making. Since the firms vary in size from small undertakings employing less than 10 to large concerns with over 600 workers, a better idea of the relative importance of the different clay products

(1) Fig. 1 shows clay manufacture in terms of clay body used, e.g. stoneware or earthenware ; Fig. 2 by the nature of the manufactured article, e.g. pottery or sanitary ware.

(2) This includes the firm specializing in electrical insulators.

can be obtained from employment figures. These show that 53 per cent of the labour force is engaged in pipe-ware and refractory manufacture, 24% in pottery making, 14% in bricks and terra-cotta production, and 9% in making sanitary ware. These figures emphasise the continuing dependence of the clay industy on its local supplies of pipe clays, fireclays and brick clays.

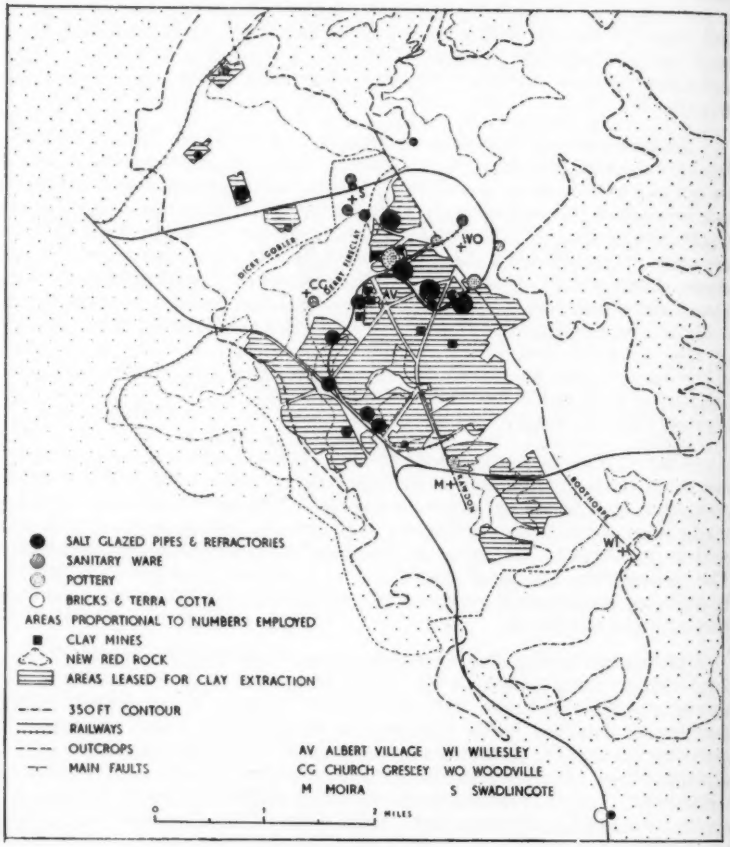

Fig. 2
Clay industries in the western basin

The Types of Clay and Their Location

The most valuable of the seatearths are contained in the Clay Measures which are preserved only in the Western Basin(1), and are bounded on the east by the Boothorpe fault and on the north, west,

(1) *East Midland Geographer*, No. 10, Dec. 1958, p. 20.

and south by the outcrop of the Dicky Gobler (Fig. 2). Near the base of these measures are two fireclays of high alumina content, the Derby Fireclay(1), and the Deep Fireclay. These clays were the basis of the early importance of the refractory industry, which still depends upon them for its high quality produce. Higher in the Clay Measure sequence are several other siliceous and alumina clays which are extensively worked ; in fact the concentration in this region of siliceous pipe clays having the virtues of plasticity and capacity of taking a salt glaze is unique in the British Isles. Pottery clays, once obtained from these rocks, are now unimportant, except in the case of the one stoneware firm. Inferior clays and binds are extracted for brick making and thin coal seams are worked by the clay firms under licence from the National Coal Board, the coal being used for boiler fuel and for the early stages of kiln firing.

The residual cover of the Clay Measures lies on a watershed which stretches from Woodville to Church Gresley and is roughly bounded by the 350 ft. contour. Erosion by streams flowing to north-west and south has removed valuable clays from the flanks of the watershed, and the greater part of the area now scheduled for extraction lies within the outcrop of the Derby Fireclay (Fig. 2).

The extraction area may be considered in two sections : the older area in the north and a newer area to the south between the Rawdon and Boothorpe faults. The older area is centred between Swadlincote and Albert Village on the crest of the watershed, where the greatest thickness of the Clay Measures remains. Structurally the Measures are arranged in a shallow basin with its centre near Albert Village. The open holes from which clay is extracted cover wide areas adjacent to the works, and may be over 100 ft. deep. The overburden is removed mechanically but the valuable clays are generally hand dug to enable iron nodules to be picked out(2). Where the overburden exceeds 100 ft. the clays are obtained from shallow mines and drifts ; the greatest depth of mining is about 300 ft. and is confined to the valuable Derby Deep Fireclays. The clays from this area are used almost entirely in the adjacent clay works, only very small quantities being sent out of the region.

The new extraction area in the south, towards Willesley, lies in a down-faulted trough between the Boothorpe and Rawdon faults where clays much higher in the Clay Measure sequence occur. The valuable pipe and refractory clays of the north lie here at a greater depth, and because of lateral variation in the nature of the clay beds it is unlikely that these deeper clays will possess the same characteristics as they do in the older extraction area, and they may be of little value. The pipe and refractory clays which are worked are of an inferior quality and unlike the clays of the older area are not used nearby. A considerable amount is sent to the Stoke and Dudley areas, some to the Eastern Basin, and the remainder to the clay firms in the north.

In addition to the Clay Measures there are several other seatearths in the Main Coal Belt which have been worked from time to time in

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(1) The Derby Fireclay, or Crucible Clay, has an alumina content of about 35%.

(2) As a result of labour shortages mechanical digging is now replacing hand digging.

conjunction with deep mined coals, and at their outcrop at the northern end of the Western and Eastern Basins. These seatearths are of a poorer quality and are only used for pipes and common bricks. It is unlikely that they will ever be mined in large quantities, even when the Clay Measures approach exhaustion, since the cost of extraction would make it economically impossible for manufacturers to compete with more cheaply produced concrete pipes.

Imported Materials

Since there are now no local clays suitable for earthenware manufacture, this branch relies on imported cane firing clays from the Cannock Chase and Shropshire coal measures or from the Peterborough ironstone area, and China clay, Dorset clay, flint and Cornish stone from Cornwall and Dorset. Dorset clay is also used occasionally for acid-resisting pipes, since none of the local clays produce such a dense and impermeable body(1). In some cases, particularly by small firms, the earthenware and sagger clays are imported in a ready-mixed plastic condition. The proportion of imported clays is insignificant when compared with the large quantities of local clay used.

Other imported materials comprise salt and borax from Cheshire, for the pipe industry, ground and calcined flints, grog, and glaze materials. There is a notable absence of ancillary trades in the area, there being only one flint mill which is owned by the large domestic earthenware firm. This is due to the small demand for such products in a region predominantly concerned with the refractory and stoneware trade.

The Location of the Clay Works

It is apparent that the types of clay-ware produced in this region are essentially determined by the properties of the Clay Measure seatearths, and that the location of clay works within the region is closely related to the distribution of these clays. Figure 1 shows that 32 out of 42 clay works are in the Western Basin, and are concentrated at the northern end where the valuable Clay Measures are thickest. These 32 works employ five-sixths of the labour force in the industry and produce all the domestic earthenware and sanitary ware, most of the sanitary pipes, and with the exception of a very small firm in the Eastern Basin, all the refractories. The Eastern Basin affords a striking contrast in that it contains only 10 clay works, well scattered throughout the basin, and mainly manufacturing bricks.

The more widespread distribution of the industry in the Eastern Basin indicates that, in the absence of the valuable seatearths of the Clay Measures, fuel supply is the most important locating factor(2). Three-quarters of the productive coal measures in this basin are concealed beneath a cover of Keuper Marl, the source of the brick clays: all the works were therefore sited adjacent to the collieries. Many of the brick

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(1) B.S.S. for acid resisting pipes stipulates a 2 - 3% porosity.

(2) The cost of fuel is invariably greater than that of the clay used. This is not surprising since the thermal efficiency of the intermittent down-draught kilns (the type mainly used) is approximately 10%.

works were built and owned by the colliery firms which also used deep-mined clays for making bricks and pipes. Today, only one pipe works uses a Main Coal Belt clay, the Middle Lount clay, which is deep mined and also worked at its outcrop in the north of the Basin. The remaining stoneware firms import their clays from the Western Basin.

In the Western Basin, it is the distribution of the better clays which has determined the position of the clay pits and works. Coal is readily available from the collieries on the exposed coal measures ; four of the largest lie within the outcrop of the Dicky Gobler seam. In addition, a certain amount of coal is worked along with the clay in the open holes of the larger works. The greatest concentration of clay works is between Swadlincote, Woodville, Albert Village, and Church Gresley, that is, on the watershed where the valuable clays are thickest. Here are all the oldest and largest firms manufacturing virtually all the refractory products, almost all the domestic pottery, and the greater part of the sanitary ware and salt-glazed pipe ware. The continuation of earthenware production in this area, despite the exhaustion of former pottery clays, is due to the existence of plant, a skilled labour force, fuel supply, and the degree of specialization which characterizes the industry.

A second group of works is situated in the valley of the south-flowing Hooborough Brook. This stream has exposed several of the valuable seatearths along its valley sides and provided an easy gradien followed by the Ashby Canal, and later by the railway. North of the Dicky Gobler outcrop is a third group of small firms which once worked the poorer clays of the Main Coal Belt seatearths, but which now import their clays from the south.

The new extraction area in the south contains only one works, producing stoneware pottery. The large brick and terra-cotta firm on the southern, concealed part of the coalfield works the Keuper Marl, is alongside a railway, and within one mile of Measham colliery.

The concentration of this extractive industry on the Clay Measures of the Western Basin has resulted in a distinctive and unattractive landscape which is probably unique in the British Isles. The clay holes and waste tips extend throughout the area and because of their long and at times inactive life they become permanent features. The clay works continually emit smoke and salt fumes, polluting the atmosphere and inhibiting vegetative growth. Like the clay holes, they cover large areas with their kilns, piles of clay for weathering and blending, stockyards, and saggar tips. Some form part of the main street of the town, as in Swadlincote ; others sprawl in the middle of derelict and abandoned waste land with little more than a dirt road linking them with the highway. The settlements are interspersed between the works and holes—small groups of houses enveloped in the gloom of a perpetual smoke-pall. In addition to this surface disfigurement, the area is severely affected by subsidence caused by mining the several thick coal seams in the relatively shallow coal measures and by clay mining which never exceeds a depth of 300 feet.

Distribution of Clay Products

It has not been possible to analyse the distribution of clay products from the region, but the pattern appears to be influenced by three factors : the status of the area as the largest producer of high-quality

pipe-ware in the U.K.; its position on the south-eastern edge of the midland coalfields; and the specialized nature of its earthenware products. As with coal, most of the pipes are sent south and east(1); practically nothing is sold north of a line from Hull to Liverpool, in areas which other coalfield producers are better situated to serve. Refractory products are used in the metallurgical industries which lie to the west, north, and south. Sanitary ware and pottery have a countrywide sale and also important export markets, several firms exporting up to 50 per cent of their production, to Western Europe, the U.S.A., and the Near East, and in the case of sanitary stoneware to the Far East.

Future Development

The industry is faced with three main problems which are likely to affect its future development, and the most pressing of these is a decreasing labour supply. In 1938 the clay industry employed 30 per cent of the total employees in the Primary and Secondary industries. This figure fell to 16 per cent in 1954. The decrease, representing a loss of 2,000 workers, can be attributed to the attraction of better-paid work elsewhere in the area, for during these sixteen years man-power in the mines increased by 3,700, and in the engineering industries by 2,500. This decline is a serious handicap to an industry which requires a great deal of manual labour. Most of the stoneware is fired in intermittent bee-hive kilns which must be stacked, fired, and emptied by hand. This type of kiln is the only one which can be used by the pipe trade since it is suitable for the only satisfactory method of salt-glazing the pipes. Moreover, it is ideally suited to a trade which must provide a vast variety of products, often in small numbers. Furthermore, the pipe and brick trades, particularly, require a great deal of labour for handling the products before and after firing, in drying sheds and in stockyards. Some of the larger firms have installed continuous kilns for earthenware, but many of the smaller firms appear to be unable to afford this re-organization and will continue to use the inefficient intermittent bottle kilns.

Because of this labour shortage, firms are experiencing increasing difficulty in maintaining full production, and the shortage has contributed to the closing down of some decorative and roofing-tile works. Moreover the decreasing number of young recruits to an industry which requires skilled labour may be expected to lead to further difficulties. The problem could be partly overcome by introducing new working methods, such as mechanical handling, and by rationalising the pipe-ware products, for the great variety of pipes and fittings (often requiring hand moulding) demanded by the building trade is a deterrent to efficient organization. The need for standardization is widely recognized and would be of great advantage to the manufacturers.

The industry is also faced with competition in its traditional markets from non-clay products. The cheapness of roofing tiles produced by methods which do not involve high fuel costs has contributed to the decline in the manufacture of clay tiles. Similarly the salt-glazed pipe trade has been affected to some extent by more cheaply

(1) *East Midland Geographer*, No. 10, Dec. 1958, p. 25.

produced concrete pipes, and large-diameter pipes, that is those over 36 inches, are now generally made of concrete, despite the superior resistance to corrosion of salt-glazed sanitary pipes and their much longer life. The extent to which pipes made from plastic material will affect the stoneware pipe trade is problematical. Pottery ware must also compete with tinned, glass and plastic products. Despite the introduction of these new materials, it appears unlikely that they will seriously affect the clay industry in the foreseeable future.

A third important factor which will influence the future development of the industry is the extent of clay reserves. The valuable refractory and pipe clays in the older extraction area have been worked since the early nineteenth century, and are expected to last for a further 50 years. The ultimate limit of their future extraction depends on the degree to which open-hole working may be possible. At present pits 120 ft. deep are in operation and overburden is removed at an economic ratio of 4 : 1, but if this depth can be exceeded by a greater use of earth-moving equipment, it will be possible to expose the clay seams which at present can only be reached by mining. There are also large quantities of valuable clay, sterilized under existing settlements, which cannot be mined because of subsidence problems and which will probably remain unworked. Of the remaining clay reserves, those in the new extraction area are the most important, and include pipe and refractory clays which, although inferior to those in the older area, could supply the industry for a much longer time.

Summary

The clay industry began in this coalfield over 150 years ago, and expanded rapidly during the nineteenth century, helped by the growth of the railways and an increasing demand for sanitary pipes. The valuable pipe and refractory clays of the South Derbyshire Clay Measures led to a concentration of the industry in this region, and the consequent development of a cultural landscape which well illustrates the effect of the unplanned activities of a long-established extractive industry. The main products from this area are salt-glazed pipes and refractories, earthenware (now dependent on imported clays), and sanitary ware. By contrast, the Leicestershire side of the coalfield is mainly concerned with brick making. Apart from the movement of some clay from the Willesley area to the Eastern Basin, the clay industries in each basin are completely independent. Although the industry is faced with labour problems and competition from non-clay products, the reserves of the most valuable clays will be adequate for a further 50 years. It therefore seems unlikely that there will be any major change in the character of the industry before the end of the present century.

REBUILDING THE CENTRE OF COVENTRY

HENRY REES

The city of Coventry has a distinctive character which owes much to its particular course of industrial development. The special problems and opportunities presented by the need to re-develop the greater part of its central area are therefore best viewed in an historical perspective. Already a substantial walled settlement, and a flourishing centre of the cloth industry in the Middle Ages, the city became important for watch making and ribbon weaving in the nineteenth century—a phase of economic development which has its monument in the rows of old, red-brick, three-storey dwellings with wide-windowed attic workshops, which still survive in the central areas. In the later nineteenth and the twentieth centuries Coventry's industrial evolution took a new turn, and the city pioneered in new forms of transport, becoming the birth-place successively of the bicycle, motorcar and jet aircraft industries, as well as engaging substantially in the telephone, radio and machine tool industries. Much of this industrial growth took place in the area which has now become the central part of a much larger city. With it the population has quadrupled in the last half-century, an increase from 70,000 in 1901 to 277,000 representing a rate of growth which is unmatched among towns of this rank in the United Kingdom. The rapid population growth, coupled with the central congestion of Coventry, brought serious problems of urban organization into being. The destruction of the centre of the city by bombing has afforded the opportunity of reconstructing it according to a plan which will not only improve the congested and heterogeneous condition of the pre-war city centre, but which envisages a city core with ample space and amenities to function as a true centre of city life, efficiently satisfying modern needs.

As a centre of aircraft manufacture Coventry attracted the early attention of enemy bombers in the second world war, and in three severe air attacks on 14 November 1940 and 8 and 10 April 1941, almost the entire central area was laid waste. The concentration of destruction in the central area around the cathedral is understandable in view of the considerable concentration there of the engineering industry—in part a consequence of its early establishment. This article is largely concerned with the rebuilding of this area, the almost complete replacement of the heart of the city. The area is described first as it was in 1937, and then as it is now coming into being.

THE CENTRAL AREA IN 1937

The central area of Coventry in 1937 is shown in Figure 1. Figure 2 shows the same area according to the development plan, much of which has already been implemented. In 1937 the lines of many of the streets in the central area remained as John Speed had drawn them in 1610, although the Sherbourne stream had been culverted in places, and most of the city wall and all but two of the twelve gates had been demolished. In many parts rows of small cottages had been built at right angles to the roads in what were earlier the gardens of well-to-do citizens, a process which explains the peculiar striped appearance of the building pattern in parts of the south-eastern quadrant and elsewhere. In one

remarkable instance 20 tiny houses were crammed into a narrow strip of land which Samuel Bradford, in his survey of 1748 - 9, had shown as a single garden, and which is now occupied by part of the new police headquarters. In other areas similar small houses, some of them literally back-to-back, were grouped around communal courts to economise in space. Such courts may be noticed in Figure 1 in the congested area immediately east of the cathedral, and there are others just outside the planned inner ring road. A number are still occupied, but by the end of 1959 they should have disappeared through redevelopment. By contrast, towards the south and south-west, substantial terraced houses had been built, together with a few large detached residences. This is the only residential area to be incorporated unchanged into the development plan.

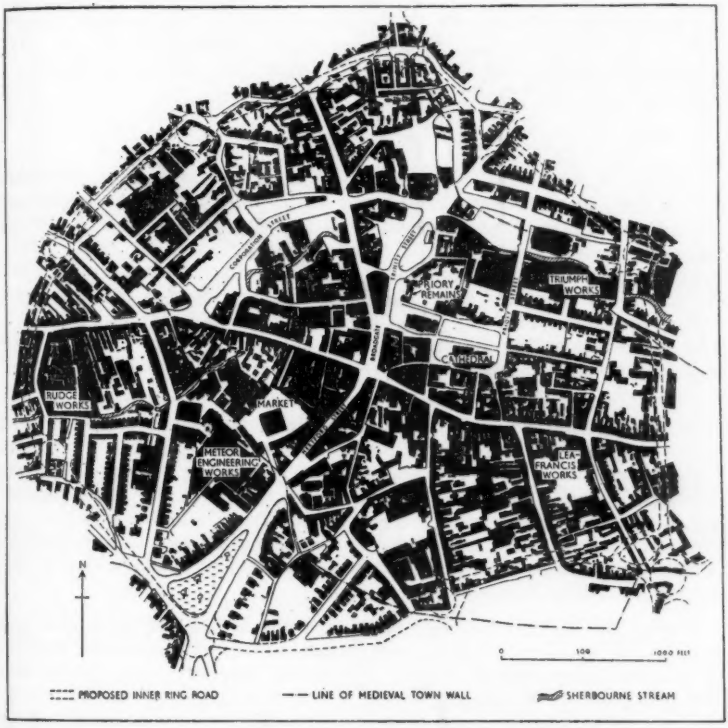

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Fig. 1
The central area of Coventry in 1937

The larger shaded blocks of Figure 1 represent large engineering plant. North of the cathedral, and spreading across Priory Street, were the Triumph motor cycle works; to the south-east were the Lea-Francis cycle works; beyond the square covered market to the south-west were the Meteor engineering works, and to the west the Rudge cycle and motorcycle works, probably the world's largest in

their day. Now the cycle industry has left Coventry; the motor car works, needing more space, are established on or near the outskirts of the built-up area ; and the oblong red brick structure which was formerly the Rudge works is occupied by the General Electric Company making radio and television equipment.

Even between the wars it had become apparent that drastic replanning of the central area was necessary, and Figure 1 shows that a beginning had been made before 1937. In the north-west quadrant a wide new road, Corporation Street, had been driven through an area of shops, inns, warehouses and crowded courts to form a much-needed by-pass to the central crossroads, open by 1931. Six years later came a second improvement scheme, that of Trinity Street, immediately north of Broadgate, which substituted a broad and direct road for the tortuous lanes which had formed the north-eastern exit from the city, and entailed the destruction of some of the oldest and most picturesque streets, narrow and cobbled and flanked by half-timbered shops. In 1937 neither Corporation Street nor Trinity Street was yet completely bordered by buildings (Fig.1).

The New Plan

In 1938, with what now appears to have been prophetic foresight, a City Architectural Department was set up in Coventry, and although the art of modern town planning was scarcely in existence, a scheme for a new civic centre was evolved, and exhibited in 1940. "So", in the words of a former member of the City Architect's staff, "when the centre of Coventry practically vanished six months later we were better prepared than any other city for such a disaster . . . . . The experimental model became the nucleus of a new plan, which now embraced the whole central area"(1). To this plan we now turn.

Its fundamental principle is simple. A city serves many needs—cultural, spiritual, administrative, social, industrial and residential—and these needs are met most effectively if the buildings which serve them are concentrated into distinct areas : hence functional zones are developed which combine to form the central area. The town planner did not invent these zones ; he recognised them in embryo in the pre-war city : but he made them tidier in the new plan, and he enlarged the civic area southwards and eastwards at the expense of outmoded houses interspersed with factories.

Post-war reconstruction began with the laying out of a new and enlarged Broadgate, at the very centre of the city, on the summit of the sandstone hill on which the Saxon nunnery was established. The north side of Broadgate is occupied by the largest store in the city. On the south side a clock tower incorporates a famous locally-made clock, and adjoining this is a bridge over Hertford Street, with a civic restaurant on its lower level and offices above. The east side, at present occupied by temporary shops, is to be cleared in order to provide an open view of the cathedral area. The west side includes the entrance to the shopping precinct, with the largest hotel in the city, the Leofric, to the right, and Broadgate House to the left. The latter block comprises

(1) Percy Johnson-Marshall, *The Listener*, 17 April 1958.

shops on the ground floor, offices on the upper floors, and between them the Home and Fashion Store : here many specialist retail firms have premises under one roof, to the great convenience of the shopper.

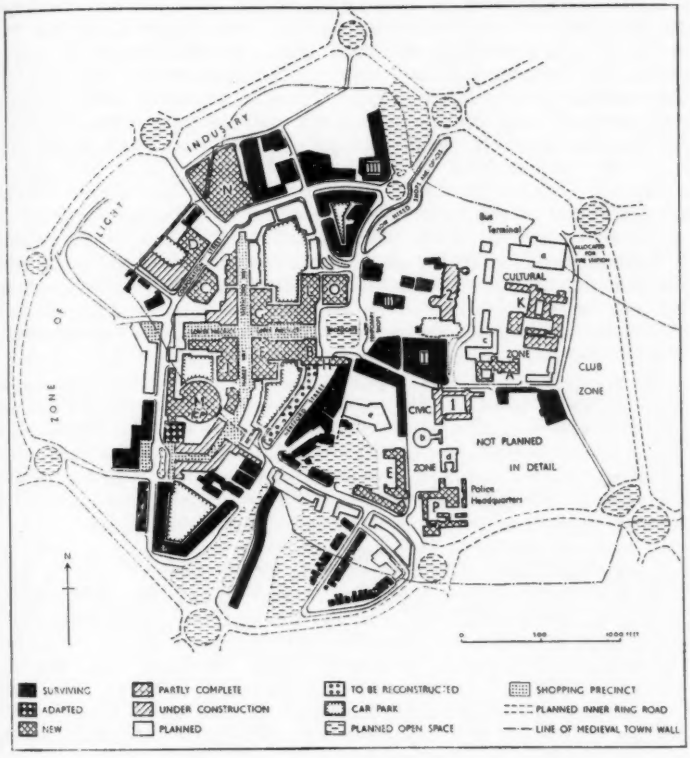

Fig. 2
The central area of Coventry in 1959

Key

Undamaged
I — Council House
II — Holy Trinity Church
III — Coventry Theatre

Under construction
1 — Council House extension
2 — Cathedral

Not yet begun
a — Central swimming baths
b — Civic Hall
c — Central Library
d — Law Courts
e — General Post Office

New and completed
A — Art Gallery and Museum
B — Broadgate House
C — Co-operative Society store
D — Belgrade Theatre
E — Central Telephone Exchange
F — British Home Stores
G — Marks and Spencers
H — Hertford Street Bridge
J — Woolworth's store
K — College of Art and Technology (phase I only complete)
L — Hotel Leofric
M — Retail Market
N — Coventry Evening Telegraph building
O — Owen Owen store
P — Police headquarters

Perhaps the most characteristic feature of the central area development is the shopping precinct, where wheeled traffic is banned and young children are safe from the risk of road accidents. All frontages are protected from rain, and there is ample paved space

for circulation, and sculpture, fountains, flower beds, Japanese Cherry trees and a children's roundabout. As can be seen in Figure 2, the precinct is roughly cruciform. The Upper and Lower Precincts have been arranged exactly on an east-west axis, in line with the cathedral spire and the centre of the Broadgate island. The design is formal, with massive blocks matching on either side. In addition to the Hotel Leofric and Broadgate House, here are the chain stores, together with many smaller shops. Shopping is on two levels, rather like the Rows of Chester. The ground slopes down fairly steeply from Broadgate (290 feet) to the river Sherbourne (about 260 feet) which is culverted across the western end of the Lower Precinct. This has made it possible to equate the lower shopping level of the Upper Precinct with the upper level of the Lower Precinct. If two-tier shopping has not proved entirely successful the method of letting may be responsible, for it was intended to reserve the upper storey for hairdressers, dentists, opticians and the like, who are usually visited by appointment. Market Way and Smithford Way, which form the north-south axis, are more intimate in design, with shops which include butchers, bakers, grocers and fishmongers.

At the four terminals of the precinct an exceptional demand for public transport is expected, and bus bays will be provided in order to increase safety and minimise interference with through traffic. But already many people shop by car. In Coventry 11.5 per cent of the population own cars—a figure which is almost 50 per cent higher than the national average—and the planners are looking forward to the time when there is a car for every family. In such conditions a shopping centre without adequate parking facilities would be at a great disadvantage and, accordingly, space for 3,000 parked cars is being provided within the main shopping area. As Figure 2 indicates, there are car parks in three of the angles of the shopping precinct : each will be three or more storeys high eventually, and the first of them, north of the retail market, was opened in October 1959. Parking space has been provided for 200 cars on the roof of the circular retail market, where electrical heating prevents icing in winter, and on the roofs of adjoining buildings connected by bridges where necessary. Around the car parks are service roads and opening on to these are the loading bays through which the shops replenish their stocks. Every element in the shopping district thus plays its part in promoting comfort and efficiency.

The entertainment zone is adjacent to the shopping area, separated from it by Corporation Street. Here the Opera House cinema and the Coventry Theatre have long been established. Three or four hundred yards further west the Belgrade Theatre has recently been opened, the first major theatre to be completely planned and constructed by a local authority. Two other nearby sites are earmarked for cinemas, one being for the "Empire", which will be demolished when Hertford Street is widened. The entertainment zone is conveniently near the car parks of the shopping precinct, so that the parks will be in use continuously through the day.

North and west of the theatres is the zone of light industries, including textile mills, some of the smaller engineering works and the radio and television works of the General Electric Company.

The eastern half of the central area is devoted largely to religious, cultural and administrative functions. On the summit of the hill the remains of the thirteenth century church of the priory founded by

Leofric and Godiva can still be seen. Immediately to the south is Holy Trinity church, one of the few buildings to survive the bombs, and close by is St. Michael's cathedral, whose tower alone escaped destruction. On the adjoining site the new cathedral has reached roof level: its plan incorporates the ruined walls of the old cathedral. Here stone replaces the concrete, steel and brick of most of the new buildings. It is a warm red Keuper Sandstone, similar to that used in the medieval stone buildings, but brought from Hollington, north-west of Derby, where a quarry has been bought for the purpose. The foundation stone was laid in March 1956, and the new cathedral should be completed in 1962.

South of the cathedral is the civic zone. In contrast to the shopping precinct the buildings here are designed individually, and set apart informally in a garden area. A central avenue planned as a processional way leads northwards to the Council House. Dating from about 1920 this building escaped destruction, but is now inadequate for the needs of the growing city, and a large extension is being completed, to be connected with the earlier building by a bridge over the road. At the southern end of the processional way is the new telephone exchange, and, opposite, the police headquarters, which are laid out in rectangular blocks with cells, kennels, garage, gymnasium and assembly hall around a parade ground. Between the police headquarters and the Council House extension are to be the law courts and a civic hall, but these buildings, together with a considerable area to the east, have not yet been planned in detail.

North of the civic zone, and east of the cathedral quarter, is the cultural area, where the central library, museum and art gallery, college of art and technology and central swimming baths are in varying stages of development. The first phase of the college, for art, is in use, and the second phase, housing some technology, is nearing completion. The library, museum and art gallery consist of connected blocks, of which the museum and art gallery are now completed but not yet opened. Construction of the swimming baths is expected to begin in late 1959. The published designs incorporate a large competition pool suitable for international meetings, a smaller general purpose bath, a teaching pool, restaurant and games deck.

North of the civic zone about 10 acres are reserved for a new bus terminal, corresponding broadly in position with the existing bus station, but considerably more extensive. Between the civic zone and the planned inner ring road is a narrow belt, not yet planned in detail, which is intended for club premises. It is placed appropriately close to the educational and cultural buildings; but there is probably more space here than the clubs will need, and the northern portion has been allocated for a new fire station.

The central area is to be bounded by an inner ring road, the line of which is marked on Figures 1 and 2. The only portion at present constructed runs south and east of the police headquarters. Almost everywhere its line will be completely new, cutting across existing or ruined property. Just outside the ring road on the south construction of a new railway station has begun—a major project which will take five years to complete.

While the principle of zoning has been stressed it is not the intention to produce a rigid functional division in the central area. The Belgrade Theatre block includes shops, and above them, flats originally intended for visiting players ; but the eagerness with which they were taken up suggests that there is a lively demand for residential accommodation in the central area. This could not be met while family houses were in urgent demand, but the needs of business people who wish to live near their work can now be considered. Blocks of flats are accordingly being provided as terminal features of the shopping precinct, that at the northern terminal being a striking tower block of 13 storeys. Again, a row of shops has been provided within the civic zone, near to the telephone exchange.

The conception now taking shape in the central area is that of the "outdoor room", as opposed to the traditional corridor street. There will eventually be a series of connected open spaces, such as the Belgrade Square, the precincts and the Cathedral Close, intended to promote an aesthetic element of pleasant surprise as one moves from one to another.

A large part of the cost of this building programme falls on the Corporation, which is responsible for financing the swimming baths, the various link blocks in the shopping precinct, the art gallery and museum, the police headquarters, the Hertford Street bridge with its clock tower, the shops and offices comprising Broadgate House, the new council offices, the Belgrade Theatre, the retail market and adjoining multi-storey car park. These together will have cost almost £3 million. But there are many other schemes in which the Corporation is playing little or no financial part, and these include the cathedral, railway station and telephone exchange, each costing about £1 million. The Corporation is bearing part of the cost of the College of Art and Technology and of the inner ring road. There remain considerable schemes which are financed by private enterprise, including the Owen Owen block, Hotel Leofric, Co-operative store and the chain stores. In all this construction details are left to the private firms, but the Corporation exercises a general control over the height of the structures and the materials used, and ensures that all will fit harmoniously into the larger scheme.

The crowded Spon End district, immediately west of the central area, and the Hillfields district to the east, escaped the worst of the damage, but are to be completely replanned and rebuilt. There are other large areas outside the planned inner ring road in which virtually no rebuilding is taking place. This does not mean that Coventry is failing to provide new houses for those whose homes were destroyed, for, while "prefabs" remain, more than 12,000 permanent dwellings have been built in Coventry since the war, and private builders have added a further 7600—a total of 19,600 which compares with the 4600 dwellings destroyed and 50,500 damaged by air attack. This achievement was made possible by new rapid building methods, which have helped to counteract the shortage of labour, particularly acute in Coventry with its well-paid factory employment. New building is taking place chiefly on the city outskirts, and includes construction of self-contained neighbourhood units in three areas. There are blocks of flats of 11 storeys at Tile Hill, and a 17-storey block is planned for Bell Green.

At the same time it is realised that the outward spread of Coventry should be halted. During the pre-war housing boom hundreds of acres of good agricultural land were lost, and this sprawling city occupies roughly the same area as Rotterdam, though housing only one-third as many people. Accordingly, in the reduced municipal housing programme of today the emphasis is particularly upon redevelopment of the older parts of the city, mainly in four- and ten-storey blocks.

The possibility of establishing a University in the city has been under discussion for several years : Coventry, in fact, is the only city of its size except Bradford without one. A fine site on the south side of the city has been offered by the Corporation. A University would undoubtedly benefit the city by providing a stimulus to and a focus for its intellectual life.

Conclusion

The new centre of Coventry is quite different from that of twenty years ago. The urban landscape differs as markedly in elevation as in plan from that which it is replacing(1). The obliteration of such a large proportion of the central area has presented the opportunity for a more radical and unified replanning of a city centre than has been possible perhaps anywhere else in Britain. While the historical development, regional setting and particular industrial structure and tradition of the city as a whole must have been basic considerations, the planner has been less restricted than usual by the alignments, styles and functions of relict buildings and areas of value in giving material expression to his sociological and aesthetic concepts. Thus, for good or ill, the centre of Coventry will stand as a monument to the mid-twentieth century style of architecture, and to the principles of mid-twentieth century town planning.

Acknowledgment

The author gratefully acknowledges the help provided by the City Architect's Department of Coventry in the preparation of this article.

(1) The new urban landscape presents some challenging cartographic problems. For example, should not new conventional symbols be devised for features like a shopping precinct and a multi-storey car park, which is something between a building and a street ; and should not the ground plan of a bungalow housing a single family be immediately distinguishable from that of a 17-storey block of flats housing a population as large as that of a village ? Such problems will be encountered in course of time in the cartographic representation of most cities ; in Coventry they are strikingly apparent today.

THE EMPLOYMENT STRUCTURE OF THE COUNTIES OF DERBYSHIRE, LEICESTERSHIRE & NOTTINGHAMSHIRE

D. M. SMITH

An accurate description of the spatial variations in the type and intensity of economic activity is the essential pre-requisite to their explanation, which is the central task of economic geography. Geographers have become increasingly aware during recent decades that in such initial descriptive work a careful analysis and mapping of statistical material forms a fruitful beginning. The most significant guide to the relative importance of different economic activities in an area would be the income derived from them by workers in that area, but this is rarely available. However, the numbers employed in different industries are published for many parts of the world, and these can be used as a fairly reliable index of industrial structure. In the United Kingdom the Census Industry Tables, despite certain shortcomings, are a valuable source of such information.

This article is based on data from the Industry Tables of the 1951 Census(1). Its purpose is to indicate how employment statistics can be used to describe the industrial structure of a fairly large area, in this case the counties of Derbyshire, Leicestershire, and Nottinghamshire. It is thus of the nature of a continuation of an earlier article in *The East Midland Geographer* which was concerned with the employment structure of the three county towns(2). For the purposes of this broad analysis, economic activities have been divided according to the four conventional main groups, *viz.*, agriculture, mining and quarrying, manufacturing, and service industries. Manufacturing industries consist of Orders III to XVI of the Standard Industrial Classification, and service industries of Orders XVII to XXIV. The inclusion of building and contracting, and the public utilities, in the service industry group is open to question on the ground that these industries are also concerned with manufacturing; but, with the possible exception of the producing side of the gas and electricity industries, these activities have more in common with the rest of the service group than with manufacturing industries.

When the employment structures of the three counties are compared (Table 1), some important differences are immediately apparent. Agriculture is relatively less important in Nottinghamshire than in the other two counties, and mining and quarrying is more important in Derbyshire and Nottinghamshire than in Leicestershire.

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(1) Census of England and Wales, 1951, Industrial Tables, London, H.M.S.O., 1957. In these tables people are classified according to their place of work, and not place of residence, as in the Occupation Tables.

(2) E. M. Rawstron, "The employment structure of Nottingham, Derby and Leicester", *East Midland Geographer*, No. 8, Dec. 1957, pp. 45-48.

TABLE 1

NUMBERS AND PERCENTAGES OF TOTAL EMPLOYED POPULATION IN THE FOUR OCCUPATIONAL GROUPS

	Agriculture		*Mining*		*Manufacturing*		*Services*	
	No.	%	No.	%	No.	%	No.	%
Derbyshire	15,051	4.3	49,877	14.1	148,968	42.1	140,204	39.5
Leicestershire	13,318	4.3	14,562	4.7	162,062	52.2	120,360	38.8
Nottinghamshire	13,184	3.3	54,294	13.7	152,625	38.4	176,863	44.6
Total, 3 counties	41,553	3.9	118,733	11.2	463,655	43.8	437,427	41.1
England & Wales	963,749	4.8	741,517	3.7	7,532,879	37.8	10,701,879	53.7

Leicestershire has a higher proportion employed in manufacturing than the other two counties, while Nottinghamshire has a higher proportion in service industries. What is more interesting, however, is a comparison between the employment structure of the three counties together, and that of England and Wales as a whole. These East Midland counties are 0.9 per cent. below the national average for employment in agriculture; they are 7.5 per cent. above the national average for mining, and 6.0 per cent. above average for manufacturing industries, but as much as 12.6 per cent. below average for service industries.

The total number of people employed in the three counties in 1951 was 1,061,368, or just over 5 per cent. of all those employed in England and Wales. Of these, 396,966 were employed in Nottinghamshire, 354,100 in Derbyshire, and 310,302 in Leicestershire. The distribution of this employed population is shown on Figure 1, on which the administrative areas are designated by numbers relating to the names in the key below the map. From this and subsequent maps the High Peak County Council area of Derbyshire is excluded, as it is economically part of the South Lancashire industrial area rather than of the East Midlands.

The map is dominated by the cities of Derby, Leicester, and Nottingham, which together employ 438,000 people, or 41.5 per cent. of the total in the three counties. Secondary centres of employment are Chesterfield, with 32,000, Beeston and Stapleford with 29,000, and Mansfield, Loughborough and Hinckley with about 20,000 each. The rest of the employed population is concentrated in the smaller boroughs and urban districts, and spread out over the rural districts. It will be seen that there is a noticeable concentration in the belt which runs from Hinckley and Leicester in the south, through Derby and Nottingham north to the Derbyshire boundary, across which it is continued in the Sheffield area. This concentration is especially pronounced north of Derby and Nottingham, in the coalfield area.

A distinction is drawn in Figure 1 between males and females and there are some interesting variations in the sex balance of employed population within the three counties. The proportion of female to total employed population varies from 7.6 per cent. in Ashby Woulds and 7.9 per cent. in Staveley to 44.9 in Hinckley, 45.6 in Shepshed, and 46.3

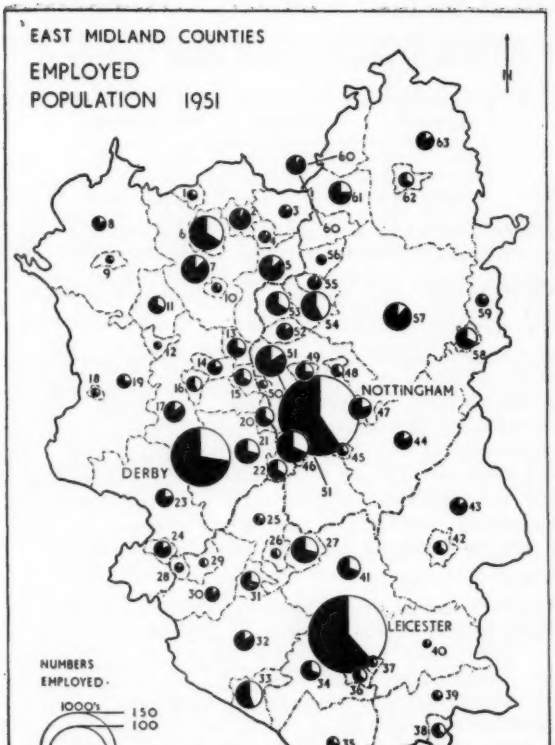

Fig. 1

Key to administrative areas identified by numbers

Derbyshire

13 Alfreton U.D.
18 Ashbourne U.D.
19 Ashbourne R.D.
9 Bakewell U.D.
8 Bakewell R.D.
16 Belper U.D.
17 Belper R.D.
5 Blackwell R.D.
4 Bolsover U.D.
6 Chesterfield M.B.
7 Chesterfield R.D.
10 Clay Cross U.D.
3 Clowne R.D.
1 Dronfield U.D.
15 Heanor U.D.
20 Ilkeston M.B.
22 Long Eaton U.D.
11 Matlock U.D.
23 Repton R.D.
14 Ripley U.D.
21 Shardlow R. D.
2 Staveley U.D.
24 Swadlincote U.D.
12 Wirksworth U.D.

Leicestershire

29 Ashby de la Zouch U.D.
30 Ashby de la Zouch R.D.
28 Ashby Woulds U.D.
41 Barrow upon Soar R.D.
40 Billesdon R.D.
34 Blaby R.D.
25 Castle Donington R.D.
31 Coalville U.D.
33 Hinckley U.D.
27 Loughborough M.B.
35 Lutterworth R.D.
32 Market Bosworth R.D.
38 Market Harborough U.D.
39 Market Harborough R.D.
43 Melton and Belvoir R.D.
42 Melton Mowbray U.D.
37 Oadby U.D.
26 Shepshed U.D.
36 Wigston U.D.

Nottinghamshire

48 Arnold U.D.
51 Basford R.D.
46 Beeston and Stapleford U.D
44 Bingham R.D.
47 Carlton U.D.
62 East Retford M.B.
63 East Retford R.D.
50 Eastwood U.D.
49 Hucknall U.D.
52 Kirkby-in-Ashfield U.D.
54 Mansfield M.B.
55 Mansfield Woodhouse U.D.
58 Newark M.B.
59 Newark R.D.
57 Southwell R.D.
53 Sutton-in-Ashfield U.D.
56 Warsop U.D.
45 West Bridgford U.D.
61 Worksop U.D.
60 Worksop R.D.

per cent. in Belper. Female employment is generally below the average for the three counties in the rural districts, and in the northern part of the central belt female employment is relatively less important than in the south. Derbyshire, with 23.2 per cent. females, is well below the national average of 30.9 per cent., while Leicestershire (34.9 per cent.) is above average. Nottinghamshire (31.1 per cent.), and the average for the three counties (30.6 per cent.), conform closely to the national average.

Variations in employment structure over the three counties will now be examined by comparing each of its four main components with total employment. The shading of administrative areas, the method of mapping used, enables each component of the employment structure to be considered separately, while still being related to total employment.

Employment in Agriculture

The area in which employment in agriculture is relatively important (Fig. 2A) runs down the eastern sides of Nottinghamshire and Leicestershire into southern Leicestershire, to be continued in western Derbyshire. These rural districts enclose on three sides the main belt of employed population shown on Figure 1, in which employment in agriculture is proportionally very low.

Agricultural employment in fact varies from over 30 per cent. in some of the rural districts to less than 1 per cent. in certain urban areas, and even among the rural districts its importance varies greatly. Although making up over 20 per cent. of total employment in nine of the rural districts, and in Billesden R.D., with 51.9 per cent. in agriculture, Ashbourne R.D. (46.0 per cent.), and Melton and Belvoir R.D. (35.3 per cent.) forming the largest component, agriculture is proportionally much less important in other rural districts. In Blackwell R.D. agriculture employs only 3.1 per cent. of the total employed population, and the proportion is below 10 per cent. in the Rural Districts of Chesterfield, Clowne, Shardlow, Basford, and Worksop. In such areas as these, mining and manufacturing industries have become important alternative forms of employment.

Employment in Mining and Quarrying

Over 90 per cent. of mining and quarrying employment in the three counties is in coal mining, and of the areas shaded in Figure 2B only Bakewell R.D. and Wirksworth U.D. are more important for other mining activities than for coal mining. Of the 52,700 miners employed in Nottinghamshire 97 per cent. work in coal mining, as do 89 per cent. of the 44,600 in Derbyshire, and 87 per cent. of the 12,700 in Leicestershire. The Derbyshire and Nottinghamshire coalfield in the north, and the Leicestershire and South Derbyshire coalfield in the south, stand out distinctly on the map, but the pattern of employment in mining and quarrying is distorted by the shape of certain administrative areas, and the mining industry is shown as important over a wider area than is, in fact, the case. In Southwell R.D. coal mining extends only into the western parishes; and the southern detached part of Basford R.D., south of Nottingham, contains no coal mines.

These examples emphasise that, in interpreting preliminary maps based on data from the Industry Tables, presented according to

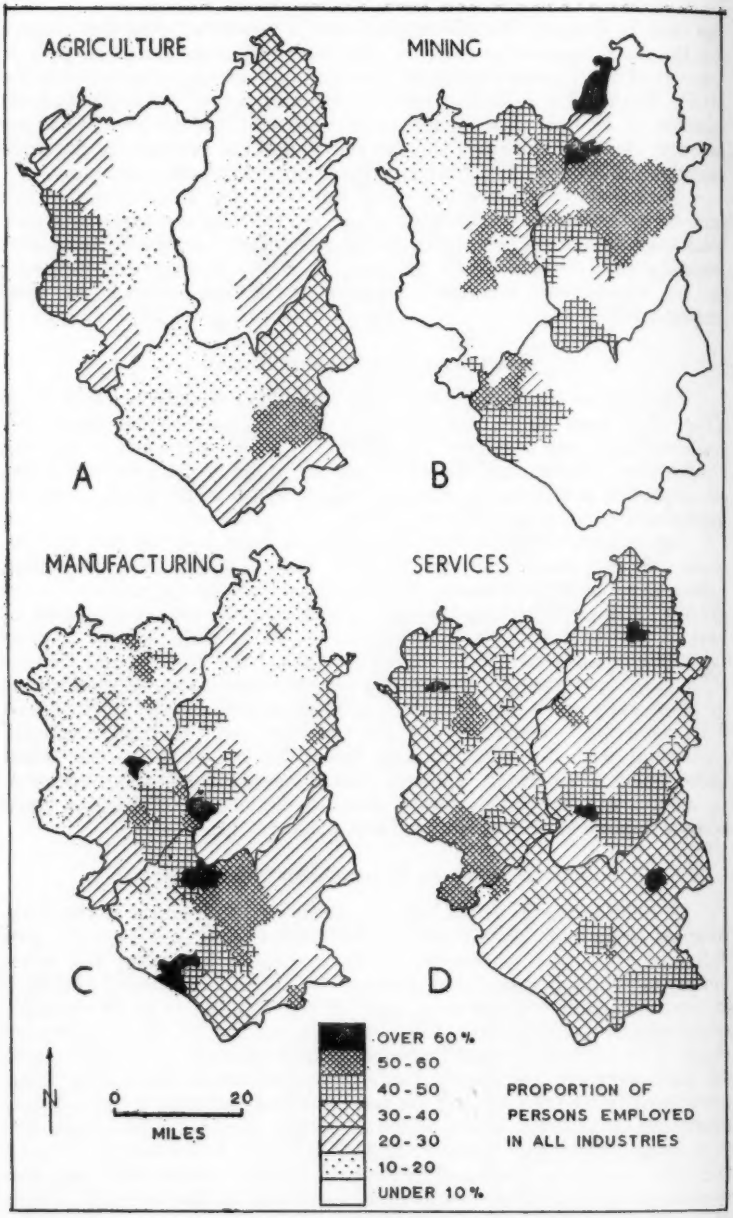

Fig. 2

Percentage of employed population in each of the four main employment groups, by administrative areas.

administrative units, the limitations of the data and of the methods used in mapping must be borne in mind. Nevertheless, some interesting facts emerge. The highest proportion employed in mining—61.9 per cent.—is found in Worksop R.D. (divided into two parts by the town of Worksop); and considerable areas of both coalfields also have over half the employed population in coal mining. The most important areas are round Mansfield, in Mansfield Woodhouse U.D., with 59.5 per cent., Blackwell R.D. (59.5 per cent.) and Kirkby-in-Ashfield U.D. (56.6 per cent.); and in Ashby Woulds U.D. (59.0 per cent.) on the Leicestershire coalfield.

These and other areas with a high proportion of employment in mining are below average for service industries, and even more so for manufacturing industries, although some towns are both mining and manufacturing centres. Examples of this type are Staveley, with 35.2 per cent. in mining, and 42.6 per cent. in manufacturing, and Sutton-in-Ashfield with 25.6 per cent. in mining and 45.5 per cent. in manufacturing.

With the exception of a few towns on the Derbyshire and Nottinghamshire coalfield, all the coalfield districts are very much above both the local and national averages for mining employment, contrasting with the surrounding areas where employment in mining is generally below 5 per cent. and in some places virtually nil.

Employment in Manufacturing Industries

There are considerable variations in the proportion of total workers engaged in manufacturing industries (Fig. 2c), although by comparison with mining and quarrying this is rather more evenly spread over the whole of the three counties. Manufacturing industry is most important in the southern part of the central concentration of employed population, extending from Hinckley and Lutterworth R.D. in the south to Belper and the Nottingham area in the north, and is considerably less important in the mining areas further north, and in the surrounding agricultural areas.

Within the main manufacturing belt four centres stand out with over 60 per cent. employment in manufacturing industries. In the north is Belper with 66 per cent., mainly in hosiery and cotton manufacture, and Beeston and Stapleford (62.7 per cent.) in which are located three very large firms, producing pharmaceutical goods, boilers, and telephones, as well as an important hosiery industry. To the south are Loughborough (63.7 per cent.), an engineering and hosiery centre, and, nearby, Shepshed (66.0 per cent.), almost entirely dependent on hosiery manufacturing. The fourth centre, Hinckley (71.7 per cent.) is primarily a hosiery centre, but also has an interest in the boot and shoe industry.

Of the three cities, all of which lie within this manufacturing belt, manufacturing has greater relative importance in Leicester (57.9 per cent.) and Derby (57.3 per cent.) than in Nottingham (49 per cent.), which is a more important service centre.

Within the belt four rural districts appear as important manufacturing areas. Barrow-upon-Soar has 52.5 per cent., Blaby 49.7, Shardlow 46.9, and Castle Donington 41.1 per cent.—high proportions which are explained by the presence of "industrial villages," or small towns. For example, in Barrow-upon-Soar R.D., such villages as Barrow-upon-

Soar, Sileby, Syston and Anstey are small centres of the boot and shoe and hosiery industries. Shardlow R.D. also contains part of Stanton ironworks.

In the mining and agricultural areas outside the main manufacturing belt employment in manufacturing falls generally to below 30 per cent., and much lower in some districts—to 6.5 in Clowne R.D., 7.2 in Southwell R.D., and 7.7 in Billesden R.D. But a few towns in these mining and agricultural areas are important isolated centres of manufacturing industry. On the Derbyshire coalfield Dronfield, Chesterfield and Clay Cross all have over 50 per cent. in manufacturing, mainly in metal and engineering industries, and the Mansfield—Sutton-in-Ashfield area is an important hosiery district. In the rural areas Newark, concentrating on engineering, and Market Harborough, with a variety of lighter industries, are important manufacturing centres. The presence of works just outside the boundary of Newark M.B. has exaggerated the importance of manufacturing industries in Newark R.D.

The main manufacturing belt running south from the Nottingham-Derby area into Leicestershire is, then, surrounded by areas in which manufacturing is much less important, but which contain a number of smaller centres with a high proportion of employment in manufacturing industries.

Employment in Service Industries(3)

Of the four main components of employment structure, service industries are the most evenly distributed, but important variations can be seen in Figure 2D. Not only do certain towns stand out as service centres, but there is a clear distinction between the mining areas on the one hand, and the manufacturing and agricultural areas on the other.

Four towns have over 60 per cent. of the employed population in service occupations, the highest proportions being in West Bridgford (77.5), followed by Melton Mowbray (67.8), East Retford (63.4), and Bakewell (62.8). A number of other places, in both the mining and the agricultural areas, have over 50 per cent. employment in service industries. These service centres are fairly evenly distributed. Of the three county towns Nottingham is the most important, with 49.4 per cent., compared with Derby's 42.5, and Leicester's 41.7 per cent.

The coal mining areas have the lowest proportions in service occupations (see Figure 2), under 30 per cent. of total employment in most areas. In the manufacturing belt the figure is generally higher, between 30 and 40 per cent., and in some of the agricultural rural districts, namely Bakewell, East Retford, Bingham, Market Harborough and Repton the proportion is over 40 per cent. The unusually high figure for Repton R.D., south west of Derby (50.7 per cent.) is to be explained by a relatively high number of workers in "medical and dental services," indicating the presence of a large hospital.

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(3) In the case of some areas an adjustment has been made to the figures for employment in "Public administration and defence", to counteract the presence of military establishments in these areas. The inclusion of H.M. Forces, and others employed in these establishments tends otherwise to overemphasise the service function of the places in question.

There are, then, several centres with over half the employed population working in service industries. Surrounding these are areas where service occupations are relatively less important, and vary according to differences in intensity of other economic activities, mining areas having a low proportion, agricultural areas a noticeably higher proportion in service industries and manufacturing areas occupying an intermediate position.

Economic Regions

The final stage in this descriptive analysis is an attempt to delimit economic regions based on employment structure. Regions thus derived provide a simple summary of variations in employment structure, and a basis for further analysis. The first successful attempts to delimit and classify economic regions from statistical data were those made by American geographers working on agricultural regions in the late 1920's and early 1930's(4). Before this, economic regions were little more than adaptations of physical regions, based on physical rather than economic criteria; and even as late as 1935 Renner could ask "Can regions be recognised and their boundaries be drawn by approaching the matter from the non-physical side? In other words, can an area's 'regionality' be discovered, and the region delineated, through the measurement of its social data?"(5)

The early work on agricultural regions did much to answer Renner's question in the affirmative. Statistical data were used to draw isopleths of crop acreage, which could be used in the delimitation of agricultural regions, and employment statistics can be used in much the same way to define objective economic regions based solely on economic criteria.

In fact, some subjective judgement must enter in deciding which of a number of values shall act as a regional limit, although there are ways in which this subjectivity can be minimised. One method is to plot all the percentage figures from each industrial group in turn, on dispersion graphs, and to look for breaks in the statistics, separating the figures for those areas in which the industry forms a relatively important component in the employment structure from those for areas where it does not. A value based on such a break can be used as a regional limit. Another method is to compare individual percentage figures with national or local averages for employment in particular industries, and to use the average as a regional limit.

Both these methods were used in preparing Figure 3, which shows a system of regions based on the analysis of employment structure. In the case of agriculture and mining, employment of over 20 per cent. in these branches was used as a regional limit, this figure representing a

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(4) Of particular relevance in this context are O. E. Baker, "Agricultural regions of North America", *Economic Geography*, various issues, vols. 2-10, 1926-1934, R. Hartshorne and S. N. Dicken, "A classification of agricultural regions of Europe and North America on a uniform statistical basis", *Annals of the Association of American Geographers*, Vol. XXV, 1935, pp. 99-120, and W. D. Jones, "Ratios and isopleth maps in regional investigation of agricultural land occupance", *Annals of Association of American Geographers*, Vol. XX, 1930, pp. 177-195.

(5) G. T. Renner, "The statistical approach to regions", *Annals of the Association of American Geographers*, Vol. XXV, 1935, pp. 137-152.

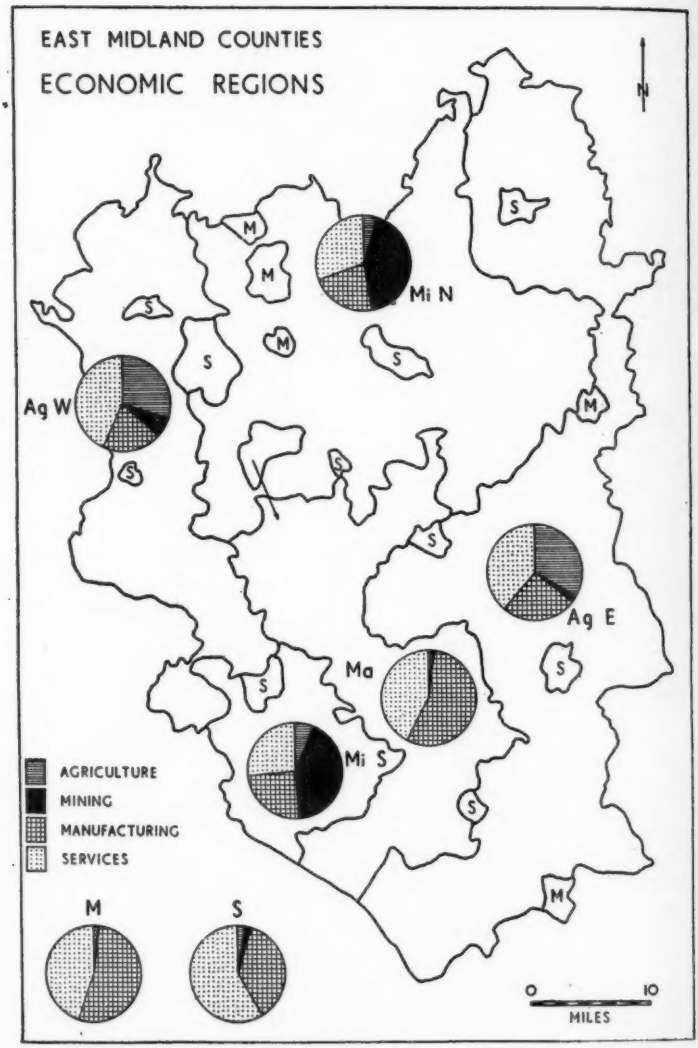

Fig. 3
Economic regions defined on the basis of employment structure of administrative areas.

Key

Ag E — Agricultural region of eastern Nottinghamshire and Leicestershire.
Ag W — Agricultural region of western Derbyshire.
Mi N — Derbyshire and Nottinghamshire mining region.
Mi S — Leicestershire and South Derbyshire mining region.
Ma — Central manufacturing region.
M — Other manufacturing centres.
S — Service centres.

significant break point in the percentage statistics for both these groups. No such break occurred in the statistics for manufacturing and service industries, and the regional limits in these cases were based on national employment averages. The manufacturing regions have over 40 per cent. of total employment in manufacturing industries, and the service centres consist of those boroughs and urban districts with over 50 per cent. in service occupations.

In order that the employment structure of each region could be shown diagrammatically on the map, it was necessary to avoid overlaps, and towns with two of the above qualifications were classified after a more detailed examination of their employment structure. Mansfield, for example, has 42.8 per cent. in manufacturing, and 54.9 per cent. in services, but the town was included as a service centre because the proportion in service industries was well above the average for the three counties, while employment in manufacturing was a little below average. Sutton-in-Ashfield, Staveley and Heanor qualified for inclusion in both mining and manufacturing regions, but were classified as mining areas because the proportion in mining exceeded the local and national average by a relatively greater figure than did the proportion in manufacturing. A further simplification has been the exclusion of the detached southern part of Basford R.D. (in the centre of Figure 2B) from the mining areas, as it contains no coal mines.

Five main economic regions are distinguished—two agricultural, two mining, and one manufacturing region. These regions consist of a number of contiguous administrative areas, except in the case of Belper and Ripley which are closely similar to the manufacturing belt to the south in employment structure and type of industries, and which are included in the manufacturing region although they are separated from it. The shape of these economic regions is, of course, determined by the shape of the administrative areas for which the employment statistics are compiled.

TABLE 2

EMPLOYMENT STRUCTURE IN THE ECONOMIC REGIONS OF THE THREE COUNTIES

Region	*Total Employed*	*Percentage of Total Employed Population in the Four Occupational Groups*				*Females as % of Total Employed Population*
		Agriculture	*Mining*	*Manufacturing*	*Services*	
Ag. E.	18,800	33.5	2.2	25.2	39.1	17.7
Ag. W.	34,100	30.2	6.8	19.5	43.5	22.8
Mi. N.	213,800	5.1	42.2	22.3	30.4	18.0
Mi. S.	39,700	6.6	42.4	24.4	26.6	18.5
Ma.	595,100	1.2	0.9	55.3	42.6	35.9
Group of Centres						
M.	55,500	1.5	0.5	53.2	44.8	33.1
S.	58,000	2.4	2.6	36.0	59.0	37.8
Average for the three counties	—	3.9	11.2	43.8	41.1	30.6

In addition to the five regions, a number of isolated centres or pockets of employment are distinguished in the map : five manufacturing towns and ten service towns. For the purposes of the description below these areas have been considered together in two groups : isolated manufacturing centres, and service centres. This scatter of service centres is to be expected, and it is doubtful whether a service region, or group of contiguous administrative areas with a high proportion in service industries, would be recognised by this type of analysis, with the possible exception of a zone of coastal resorts.

The employment structure of the five regions and the two groups of isolated centres is shown diagrammatically, and a comparison of the actual figures can be made by referring to Table 2. The five regions are as follows :—

Ag. E. The Agricultural Region of Eastern Nottinghamshire and Leicestershire.

This is the largest of the five regions, and would be still larger if the agricultural areas of Southwell R.D. were not included in the mining districts. Agriculture is a more important source of employment than manufacturing in this region, and almost as important as service industries. Female employment, at 17.7 per cent. of the total, is well below the average for the three counties, and lower than in any other region. Total employment is 34,000.

Ag.W. The Agricultural Region of Western Derbyshire.

Total employment in this region is only 19,000, and the structure of employment is closely comparable with that of the other agricultural region. The main difference is the higher proportion in mining and quarrying in this region—representing employment in limestone quarrying and lead mining.

Mi.N. The Derbyshire and Nottinghamshire Mining Region.

Employing 214,500 people, this region is second in terms of numbers employed. Mining employs about twice as many people as manufacturing, and service industries at 30.4 per cent. are considerably below average. The low proportion of female employment here, 18 per cent. compared with 30.6 per cent. for the three counties as a whole, is to be expected of a coal mining area.

Mi.S. The Leicestershire and South Derbyshire Mining Region.

This small coalfield region, employing 90,000 people, has an almost identical employment structure to the larger coalfield region. Both have about 42 per cent. in mining, and employment in manufacturing and services well below average. Female employment is again low at 18.5 per cent.

Ma. The Central Manufacturing Region.

This belt of concentration on manufacturing industry extending from the Nottingham-Derby area up the Soar valley to Leicester, and on to Hinckley, employs 595,000 people, over half the employed population of the three counties. More than 50 per cent. are engaged in manufacturing industry, and almost all the remainder in service industries. The most important single industry of the area is hosiery and knitwear,

which employs a high proportion of females, and the percentage of females to total employment in the region is above average at 35.9 per cent.

The two groups of isolated centres also distinguished on the map are :—

M. Other Manufacturing Centres.

These centres consist of the towns of Dronfield, Clay Cross, and Chesterfield, in the north-west part of the Derbyshire coalfield; and the industrial market towns of Newark and Market Harborough in the eastern agricultural region. All have over half the employed population in manufacturing industry, and are somewhat above average for female employment. Together they employ 55,000 people.

S. Service Centres.

The ten urban districts and boroughs which make up this group all have over 50 per cent. of employment in service industries, the average for the group being 59 per cent. Of these service centres, Bakewell, Ashbourne, Matlock, East Retford, and Melton Mowbray are in agricultural areas; Ashby-de-la-Zouch, Eastwood, and Mansfield are in the mining areas; and West Bridgford and Oadby are associated with their respective county towns. These service centres together provide employment for 58,000 people, of which 37.8 per cent. are females, a higher proportion than in any of the regions.

The regional system outlined above presents a rather generalised description of spatial variations in economic activity within the three counties, based solely on employment structure. Although the form of the regions is to some extent influenced by the nature of the data, and methods of mapping which have been used, these regions could be refined, to provide a more exact description, by further statistical analysis, or by investigation in the field. An important advantage of this method of preliminary description involving the delimitation of regions on a uniform statistical basis is that it can be applied universally, with the same values being taken as regional limits. In this way the country as a whole, or any part of it, may be divided into economic regions, based on economic criteria which are directly comparable; and a similar regional system may be derived for any area of the world for which the necessary statistical data are available.

THE GENERAL ELECTION OF 1959 AND POLITICAL ADHERENCE IN THE EAST MIDLANDS

The adjacent maps are designed to show the pattern of political adherence in the East Midlands and the changes revealed by a comparison of the election results of 1955 and 1959. On the basis of majorities, constituencies can be classified into several groups. Perhaps the most striking feature is the group of large Labour majorities in the Derby-Nottingham border area, representing traditional opinion in mainly urban constituencies where mining and heavy industry dominate the employment structure. This is a feature which has its counterpart on a national scale in the coalfields of South Wales, Yorkshire, Lancashire and the North-East. Smaller Labour majorities characterise other constituencies of two chief kinds : those in which rural areas are combined with urban industrial districts like those of Scunthorpe (Brigg), western Leicestershire and southern Derbyshire, and the Ise Valley of Northamptonshire ; and those of larger centres like Nottingham, Derby, Leicester, Northampton, Lincoln and Grimsby, containing manufacturing industries of a lighter kind, and with a larger proportion of people engaged in service occupations. In the two largest centres of Nottingham and Leicester, both very prosperous, Conservative opinion appears almost as strong. The more predominantly rural constituencies were in 1955 almost entirely Conservative. Conservative strength was greatest, compared with Labour's, in Horncastle, Harborough and Melton constituencies, with 66·8, 61·5 and 61 per cent respectively of the combined vote, and least in the mining constituencies of Bolsover, Ashfield, Ilkeston and Mansfield, with 21·2, 28·0, 30·8 and 31·5 per cent.

In the United Kingdom a swing of about 1·1 per cent to the Conservatives has been calculated from a comparison of votes cast in 1955 and 1959. Derived simply on a basis of comparison between votes cast for the two main parties, and leaving other parties out of the reckoning, the swing to Conservative amounted to a rather higher figure of 1·6 per cent in the East Midlands, which could be interpreted as a reflection of the comparative prosperity of the region in view of the issues upon which the election was fought. The distribution of seats between the parties changed correspondingly in the Conservatives' favour. Nottingham West, Wellingborough and South-east Derbyshire were won from Labour by Conservatives(the last by a margin of only 12 votes), increasing the Conservative seats from 17 to 20 and reducing Labour's from 25 to 22. The Conservative vote of 891,297 in 1955 increased to 950,603, while Labour's share fell from 979,551 to 976,671, to bring approximate parity between the two parties.

The swing to Conservative was not uniform over the East Midlands, and its pattern is more difficult to rationalise than that of adherence, even when the complications introduced by the appearance of alternative candidates are recognised. The two patterns do not closely match. A large tract in the north-west, comprising the whole of Nottinghamshire except the extreme south-west, along with adjacent eastern Derbyshire

POLITICAL ADHERENCE IN THE EAST MIDLANDS

and northern Leicestershire, swung to Conservative by less than the regional average. This area is mainly Labour, but Conservative in the south-east. Of the 27 constituencies surrounding it, 21 swung to Conservative by a percentage greater than the regional average. Of the remaining six Lincoln, Northampton and Peterborough swung to Conservative by less than average, while Horncastle, High Peak and Chesterfield were the only three constituencies in the region to swing to Labour. In Horncastle, the most strongly Conservative constituency in the East Midlands, the very slight swing to Labour (0·2 per cent) is not readily explicable. In Chesterfield, with the greatest swing to Labour (6·3 per cent), an intervening Liberal candidate appears to have taken mainly Conservative votes. In High Peak, also, some Conservative support seems to have shifted to the Liberal candidate, who was available in each election : but this area is linked economically with the Lancashire industrial district, where the Labour position remained strong. In other places Liberal opposition appears to have had different results. Liberal intervention was apparently indecisive except in Gainsborough, where it was associated with the highest swing to Conservative in the region (8·15 per cent), a result, presumably, of the Liberal capturing mainly Labour votes. In the adjoining constituency of Grantham a Liberal candidate stood in 1955 but not in 1959 : but here too a strong swing to Conservative, by 4.3 per cent, was recorded. Apart from these last two constituencies, and that of North-east Derbyshire where population movement from Chesterfield may be involved, the strongest swings to Conservative occurred in the urban constituencies of Nottingham, Derby, Leicester and Grimsby.

The pattern of political adherence in the East Midlands is illuminated if a comparison is made with the patterns of occupation structure in Nottinghamshire, Leicestershire and Derbyshire examined by D. Smith in an article in this issue. Election results are complicated by the presence or absence of candidates of parties other than Labour and Conservative, by the personalities of candidates and the efficiency of their campaigns, by traditional political leanings and temporary local issues, and by other imponderables, so that only the broadest interpretations of the results of a secret ballot can be valid. But in this region the fundamental significance of the occupational and related social structure, and the associated level of prosperity in individual constituencies can be discerned in the broad pattern of political attitudes. The traditional adherence of the mining and heavy industrial areas to Labour, and the Conservative sympathies of the rural agricultural districts are reflected, though with some anomalies, in the patterns of both voting majorities and swing. The prosperous manufacturing districts, and especially the chief cities, are distinct from both, and are apparently more fluid in their affiliations.

F. A. BARNES

THE SUMMER OF 1959 IN NOTTINGHAM (WOODTHORPE)

The summer of 1959 has been so exceptional in character that it is of interest to examine its climatic record, and, especially, to compare it with notable summers of the past.

For meteorological purposes the "summer" consists of the three months June, July and August, but in fine summers warm dry weather may continue through September, as in 1959. Fur the purpose of this review, therefore, the four months June to September have been taken as the summer season.

In assessing the character of any summer the chief features to be considered are temperature, rainfall and sunshine. Humidity is also a significant element, however; for not only is warm weather much more comfortable physiologically when the humidity is low, than in humid thundery conditions, but low relative humidity accentuates deficient rainfall by its drying effect on the land surface, which decreases the flow of water into rivers and reservoirs.

In 1959 a warm, very dry May formed a prelude to the fine summer. June proved to be the warmest since the exceptional June of 1950, and the driest June for ten years. It was followed by the warmest July for 25 years, with rainfall somewhat below average. The chief feature of July was the heat of the period 2nd to 8th, during which the mean maximum temperature was as high as 83.4°F. On four of the seven days 85°F was exceeded—88.0° on the 4th, 90.1° on the 5th (the highest maximum temperature of the year at Woodthorpe), 87.0° on the 7th and 86.6° on the 8th.

The mean temperature of 64.1°F in August was the highest for that month since the record August of 1947 (65.3°F), though only slightly higher than in August, 1955. Rainfall in August totalled only 0.54 inches, which is very small, and no rain at all was measured after the 13th. With the exception of 24 August the temperature rose to 80°F or above on each day from the 18th to 25th, with a maximum of 86.4° on 20th.

September was the warmest for ten years. The temperature rose to 80°F or above on four days, the largest number recorded by the writer in any September in Nottingham. Rainfall totalled only 0.17 inches, the smallest amount on record for September at Nottingham. The exceptionally genial weather continued into October, and in the first week of that month the warmth was unprecedented for the season. The mean maximum temperature for the first seven days of October at Woodthorpe was 74.7°F, and on 3 October the temperature reached 80.6°F, the highest October reading recorded in Nottingham, surpassing the 78.8°F of 6 October, 1921, and the 77.8°F in October, 1908.

Anticyclonic conditions were very predominant during the summer of 1959, and notably so through August. In consequence the Nottingham district was very free from thunderstorms, and the relative humidity was well below average, with the result that temperature usually fell

markedly in the evenings, and the nights were not generally oppressive. In southern England there were some severe thunderstorms, and London Airport had 2¾ inches of rain in 12 hours during the night of 10-11 July.

Since records began in Nottingham in 1867 the most notable summers, prior to 1959, were those of 1868, 1911, 1921, 1933, 1947, 1949 and 1955. In 1868 temperature observations were made in an early type of screen, now disused, which exaggerated day-time readings, especially in warm weather. Certain statistics relating to the remaining exceptional summers listed above are set out in Table I, in each case relating to the period June to September inclusive. The values for sunshine were recorded at the Castle, Nottingham, except those for 1921, which are for Trent Lane.

TABLE I

CLIMATIC DATA FOR SOME EXCEPTIONAL SUMMERS (JUNE TO SEPTEMBER) IN NOTTINGHAM

Year	*Abs. Max. Temp.*	*Abs. Min. Temp.*	*Mean Temp.*	*Mean Max. Temp.*	*Mean Min. Temp.*	*Mean Range*	*Rain inches*	*Rain Days*	*Sun hours*
1911	94.0	34.0	61.2	71.8	50.6	21.2	5.69	44	—
1921	90.4	37.0	60.6	69.8	51.4	18.4	7.33	34	779
1933	87.6	42.4	63.3	71.8	54.8	17.0	6.05	43	800
1947	89.0	34.0	61.9	71.4	52.5	18.9	5.51	43	654
1949	91.1	37.1	61.7	71.4	51.9	19.5	7.22	35	726
1955	84.3	35.4	60.3	69.5	51.1	18.4	5.59	33	640
1959	90.1	34.1	62.1	72.3	51.8	20.5	3.64	31	798
Woodthorpe Averages	85.0	36.0	59.1	67.9	50.4	17.5	9.0	56	629

Temperatures are in degrees F.

A brief summary of these past summers may now be given :

1911. June calls for no comment, but July, August and September were all very warm. The rainfall in July, 0.10 inches, was the lowest on record for that month, and 9 August was probably the warmest day experienced in England since reliable observations began. At Trent Lane, Nottingham, 94°F was reached; at Lincoln 96°F; and in London 100°F was reported from Greenwich (in a Glaisher screen) and 97 to 99°F from other parts of London.

1921. July was one of the warmest months on record in Nottingham, and the rainfall for the seven months January to July was as low as 7.13 inches. August, however, had a moderate temperature, and 4.7 inches of rain fell during the month. It was followed by a fine warm September and October.

1933. During this summer fine warm weather was persistent rather than intense. Sunshine was abundant.

1947. No exceptionally high temperatures occurred on individual days, but August as a whole was as warm as any on record, and with only 0.27 inches of rain was the driest August for which records exist in Nottingham.

1949. The warmth was steady rather than very intense, although 91°F was touched on 12 July. The rainfall in July was above the average, but June was very dry.

TABLE II

HUMIDITY, PRESSURE AND FREQUENCY OF HOT DAYS AT NOTTINGHAM DURING SOME YEARS WITH FINE SUMMERS.

Year	*Days in year with* over 80°F.	over 70°F.	*Mean barometric pressure (mb.) June-September*	*Mean afternoon relative humidity* (%)
1921	16	64	1020	60
1933	16	78	1017	58
1947	18	83	1016.5	56
1949	17	70	1019.5	56
1955	7	60	1018.5	58
1959	20	91	1020.5	51
Woodthorpe avge.	6	48	1015.5	60

1955. June was rather cool, with 3.6 inches of rain, and sunshine well below average, but July and August were fine, warm months, with a combined rainfall of only 1.27 inches. September was also very dry, and the main feature of this summer was the very low aggregate rainfall of only 2.00 inches for the three months July to September.

1959. The mean maximum temperature for the four summer months in 1959 was 72.3°F, which is higher than that of any other summer listed in Table I. The mean temperature was slightly below that of 1933, owing to the lower minimum temperatures. In Table II 1959 stands out for its high frequency of warm days and its low relative humidity. Sunshine was well above the average, and virtually the same as in 1933, the sunniest summer in Table I. Again, 1959 had appreciably less rain than the other summers in the Table. Only 3.64 inches was measured in the four months June to September, compared with an average of about 9 inches. From May to September inclusive only 4.22 inches fell. This appears to be the smallest rainfall ever recorded in Nottingham over five consecutive months, the previous lowest being 4.43 inches from February to June, 1921. There was an absolute drought of 23 days from 14 August to 5 September, and another of 18 days from 22 September to 9 October. There was a "partial drought" of 64 days from 14 August to 16 October. These exceptional climatic figures all reflect the fact that throughout the four months Britain, and especially England, was under the influence of anticyclonic systems to an unusual degree.

The summer of 1906 did not quite equal those shown in Table I, but one remarkable feature of that summer deserves mention. A very hot spell at the end of August and beginning of September, 1906, still stands unrivalled for so late in the season. At Trent Lane, Nottingham, the maximum temperatures on the four successive days from 31 August to 3 September inclusive were 93.0, 92.8, 94.2 and 89.8°F respectively, and 96°F was reached at Bawtry.

To sum up, after taking the various criteria into consideration, it seems reasonable to assess the summer of 1959, at least in the Nottingham district, as the most notable of the present century.

ARNOLD B. TINN.

THE HUMBOLDT AND RITTER CENTENARY

The year 1959 marks the centenary of the deaths of the two founders of modern geography, Alexander von Humboldt (1769 - 1859) and Carl Ritter (1779 - 1859). During the past months the work of these great German scholars has been commemorated in many parts of the world; and, significantly, in Berlin itself, where each laboured for a considerable period of his life, meetings were held in both West and East sectors. In Britain the event was marked at the annual meeting of the British Association for the Advancement of Science at York by an inspiring address given by Professor Carl Troll of the University of Bonn.

While trained geographers are well aware of the nature and magnitude of the contribution made by Humboldt and Ritter to the formulation of the subject as a scientific discipline and are familiar at least with the scope if not the actual content of their principal writings, the monumental *Kosmos* and Ritter's *Die Erdkunde*, the centenary provides an opportunity for serious reflection. For at a time when knowledge is advancing at a bewildering rate in so many fields there is danger, in a subject of such breadth as geography encompasses, of losing sight of its primary aim and purpose. Today, as students and teachers, we may profitably glance back to the founders for guidance. They established unequivocally and in precise terms the scope of geographical study : the association and interrelation of phenomena on the earth's surface and the differentiation, in terms of the varying phenomena, of one area from another. Not for them the half-truth of "the science of distributions" nor the misleading "study of the earth as the home of man", nor indeed any other recent shibboleth which evades the essential concept. Such devices may be permissible as a means of arousing an interest in geography at an elementary level i.e. in schools, but let no one imagine that they represent an accurate view of the subject. Unfortunately too many teachers are prone to do so.

Humboldt, trained in the natural sciences, was also a great traveller, and although he never held an academic position, he contributed enormously to many different branches of learning. Above all he brought into systematic order a vast range of facts and observations relating to the features of the earth's surface and, in his insistence upon studying phenomena in their spatial relationships, he affirmed the integral character of geography. Carl Ritter, a life-long teacher, strongly influenced by Pestalozzi, was much concerned with the methodology and organisation of the subject. As the first university professor of geography—he was appointed to a chair in Berlin in 1825—he secured through his scholarship, teaching and writing, its recognition in Germany as an academic discipline. If Humboldt was somewhat more concerned with the systematic branches of geography, particularly with regard to the physical aspects, Ritter, besides devoting attention to the human or cultural aspects, formulated a concept of regional geography which carried the latter to a stage much beyond a purely descriptive treatment. Thus to the great benefit of geography

the work and experience of these two scholars was largely complementary. Not only were they the principal founders of our subject; they also ranked among the outstanding figures in nineteenth century scientific development.

In connection with the centenary various studies, including new appraisals of Humboldt and Ritter, have been published. In this country we should note the informative contributions by Karl A. Sinnhuber in the *Scottish Geographical Magazine:* "Alexander von Humboldt" (Vol. 75, No. 2) and "Carl Ritter" (Vol. 75, No. 3). In Germany two Festschriften have appeared, each containing a summary in English : *Alexander von Humboldt, Studien zu seiner universalen Geisteshaltung*, edited by J. H. Schultze, Berlin, 1959; and *Carl Ritter zum Gedächtnis*, a special issue of *Die Erde* (90, Heft 2), Berlin, 1959.

K. C. EDWARDS.

EAST MIDLAND RECORD

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

At the Association's annual meeting held at York early in September, members of the Department of Geography of Nottingham University took a prominent part in the programme organised for Section E (Geography). The President of the Section was Professor K. C. Edwards who chose as the subject of his address "Trends in urban expansion". The full text appears in *The Advancement of Science*, Vol. XV No. 62, Sept. 1959. An important paper on "The expansion of London" was read by Mr. A. G. Powell (Ministry of Housing and Local Government) a former student, Dr. C. A. M. King and Mr. F. A. Barnes made contributions to the joint discussion with Section K (Botany) on coast erosion and coast protection, while Dr. S. R. Eyre (University of Leeds) also a former student, led an excursion to the Howardian Hills.

ANGLO-POLISH GEOGRAPHICAL SEMINAR

At the invitation of the Geographical Institute of the Polish Academy of Sciences, thirteen members of the Institute of British Geographers visited Warsaw in September to participate with leading Polish geographers in a conference on the application of Geography to Regional Planning. As president-elect of the Institute of British Geographers, Professor K. C. Edwards headed the delegation from this country. The seminar, which lasted for five days, was held in the château of Nieborów, now belonging to the Warsaw National Museum, some 50 miles from the capital. Following the conference, members of the British delegation, through the generosity of the Polish Government and the Academy of Sciences, were taken on a tour of southern Poland, visiting Lodz, Czestochowa, Opole, the Upper Silesian industrial region, the High Tatra, and Cracow (including the new iron and steel centre of Nova Huta) returning thence to Warsaw.

Beach Changes on the Lincolnshire Coast

In an article published in the *East Midland Geographer* 8,December 1957, the growth of the sand and shingle spit at Gibraltar Point, between 1951 and 1957, was traced in detail. The series of surveys made between May 1951 and April 1957 showed that the volume of the spit above 11 feet O.D. had increased at an accelerating rate, and in April 1957 a considerable area (7,100 sq. feet) was above 12 feet, O.D. (Liverpool) (M.H.S.T. 10.9 feet O.D.). However, by May 1958, when another survey was made, the rapid increase in volume of the spit had been arrested ; the area above 11 feet in May 1958 was almost exactly the same as in April 1957, but the maximum height of the spit was only 11.44 feet, although it had been nearly 13 feet in November 1957. The length of the spit at any given height had also been reduced since the 1957 survey, and its outline was somewhat simpler.

Much of the considerable loss of sand from the spit can be attributed to the effect of the prolonged periods of northerly and easterly winds during the spring tides of late March and early April, 1958. It is waves generated by winds from these directions, associated with strong seaward currents on the bottom, due to the onshore component of wind driving in the surface water, which produce the most destructive conditions on this coast, and this effect is enhanced by the abnormally high water level to which such winds give rise. The storm beach, protecting the main salting at Gibralter Point, breached during the 1953 storm-surge, was again broken through as a result of this increase of water level, and considerable dune-cliffing took place to the north of Gibraltar Point.

Since May 1958 two further surveys of the spit have been made in November 1958 and May 1959. These surveys suggest that the cessation of rapid growth of the spit was not a temporary phase in the development of the feature. Although the spit was slightly higher in November 1958 than in the previous May, it had decreased in area above 10 and 11 feet, and by May 1959, only a small proportion of the lost material had been recovered. This last addition of material resulted in a greater elevation, but the area above 10 feet was in fact smaller than at any survey since June 1955. The spit at 10 feet had thus become narrower but longer, and considerably higher. Between May 1958 and May 1959 it had increased in crest height from 11.43 to 13.16 feet, an increase of nearly $1\frac{3}{4}$ feet.

The relatively static area of the spit during the last four years is in accordance with the behaviour of the beach in front of it. Here the vertical zone within which beach profiles at different surveys lie, (the sweep zone, see *East Midland Geographer* 4, 1955) has remained stationary during the whole period of observation from 1952 to 1959. The sweep zone just north of Gibraltar Point, however, (profile 2)[1] shows a steady outward or seaward movement, indicating accretion which already seems to be affecting the development of the spit at Gibraltar Point, by decreasing the volume of material available to move south along the coast at the top of the beach. This is in accordance with the tentative forecast put forward in the paper published in *East Midland Geographer* 8, 1957.

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(1) Profile numbers are those first used in *Geography* 38, 1953, pp. 141-160 and subsequently in *East Midland Geographer* 4, 1955, pp. 18-28.

One of the most spectacular changes to take place recently is the great and rapid upward and outward growth of the beach at Seacroft, South Skegness (profile 4). The whole beach has grown upwards, but near mean high spring tide level an increase of material to a thickness of 8 to 9 feet occurred over a width of beach of nearly 200 feet, during the 6-month period from November 1958 to May 1959. This illustrates the process by which outgrowth of the coast eastwards takes place by beach ridge development. The zone of accretion, which in May 1959 was 1½ feet above mean high spring tide level, has been raised a further foot in height as shown by the latest survey in November 1959. The runnel to landward of the high ridge, now 7 feet deep, is covered with thick mud. The ridge to landward of this high ridge and deep runnel have become sufficiently protected to allow a few plants of *Agropyron junceum* to become established, while one or two shoots of *Spartina* are found in the muddy runnel to landward.

Further north along the Lincolnshire coast the beach profiles illustrate the effectiveness of the groynes, the latest series of which were put in the beach by 1955, in raising the sand level on the upper beach. This is apparent on the profile north of Chapel Point(15) and at Sutton-on-Sea (profile 19) and at Mablethorpe (profile 21). At Anderby Creek (profile 17), on the other hand, there is a continuing loss of sand. This is probably due to accretion to the north, which has trapped much of the small amount of sand available to move south. At Sea Bank Farm, (profile 18) between Sandilands and Anderby Creek, only a small amount of accretion has taken place, which confirms that little sand is available to build up the beach, owing to the groynes to the north. These have been trapping most of the available supply in the zone where material is in short supply ; there is, therefore, little sand travelling south to Anderby, which is continuously losing sand southwards as a result. This is further confirmed by the rapid gain north of Chapel Point (profile 15).

It is interesting to note that apart from Sea Bank Farm (profile 18) already mentioned, the two profiles which show least accretion north of Skegness are profiles 13 and 14. These are situated immediately to the north of the concrete points of Ingoldmells and Chapel Point respectively. This suggests that the points have an adverse effect on the accumulation of beach material.

As beach surveys have now been continued for nearly a decade a rational pattern of movement on the Lincolnshire beaches is beginning to emerge quite clearly. It can be related to the coastal defence works in the north and to the movement of the offshore banks in the southern part of the coast.

C.A.M.K.

Gibraltar Point Field Research Station

The Lincolnshire Naturalists' Trust has recently secured from Lindsey County Council a long lease of the Old Coastguard House at Gibraltar Point, and grants from the Nature Conservancy, the Lindsey County Herb Committee and the Lindsey Education Committee have enabled the Trust to convert the House into a field station with residential accommodation for up to fifteen people. There is sleeping accommodation in small bedrooms and a dormitory, a small but

well-fitted laboratory with simple equipment and apparatus, and a large common room and lecture room. All facilities for cooking are provided, and although the Trust does not undertake catering a restaurant at Seacroft three miles away will provide meals by arrangement. The station has a mains water supply, and cooking and lighting are by Calor gas. During 1960 the Trust hopes to appoint a full-time warden for the Gibraltar Point Nature Reserve, who will be housed at the field station.

The Trust is in touch with those institutions (notably the University of Nottingham), organisations and individuals who have previously used the Nature Reserves and the field station and bird observatory for research and training purposes. It intends to set up an Advisory Committee for the field station which will keep under review all the research and educational activities, and advise about scientific equipment and about the scientific management of the Nature Reserves. Representatives of the principal users of the field station and others with special qualifications will be invited to serve on this Committee.

The Trust wishes to encourage the fullest use of the new field station, and will welcome enquiries about accommodation (the fee for which has been fixed for 1960 at 6/- per head per day, or 7/6 per day for weekend visitors only) from institutions, organisations and individuals. A prospectus will be obtainable in the early spring of 1960 from the Honorary Secretary at Pyewipes, Willoughby, Alford, Lincs.

The acquisition of the Coastguard House coincides with the formal extension of the Gibraltar Point Nature Reserve by the Lindsey County Council. This Reserve and the Skegness Reserve to the north of it now cover at least 1300 acres of sand-dunes, salt-marshes and foreshore, a stretch of nearly three miles of coastline which offers an excellent epitome of the biological and geomorphological forms and processes of low coasts. A management plan for the Reserves has recently been presented to the two Local Authorities by the Naturalists' Trust, which is responsible for many aspects of management.

Opportunities and facilities for study and research are also offered to the physical geographer as well as to the biologist and geologist by the other nature reserves in Lincolnshire owned or leased by the Naturalists' Trust. These include the fen relicts of Epworth and Haxey Turbaries in the Isle of Axholme ; the blown-sand heaths and woodlands of Scotton Common and Linwood Warren ; and the Saltfleetby-Theddlethorpe dunes which provide an interesting comparison with conditions at Gibraltar Point. At most of these Reserves the Trust has provided a field laboratory hut, and welcomes scientists and students wishing to work there. Enquiries should be made of the Honorary Secretary of the Trust.

A.E.S.

Botanical Studies at Gibraltar Point Nature Reserve

The Gibraltar Point Reserve contains extensive mud flats and well developed sand dune and salt marsh systems, and these are the subjects of specialised studies being carried out by members of the Botany Department of Nottingham University.

One of the most characteristic plants of the sand dunes is the sea buckthorn *(Hippophaë rhamnoides)*, a large shrub bearing numerous large spines. The plant produces vigorous and long underground stems which give rise at intervals to aerial shoots. The female flowers, which are borne on separate bushes from the male, produce large numbers of bright orange fruits every year. The biology of the sea buckthorn is being studied by Dr. M. C. Pearson and Mr. J. A. Rogers, with particular reference to the factors governing the germination of the seed and the subsequent establishment of the seedling. The vegetative reproduction of *Hippophaë* and its vegetative propagation by artificial means are also of special interest. In connection with their work they will be pleased to receive samples of fruits collected in this country and on the Continent.

Professor C. G. C. Chesters and Dr. A. Apinis are studying the fungal flora of the sea couch grass *(Agropyron pungens)*, an important salt marsh plant, and of other grasses found on the salt marsh and sand dunes. The fungal flora of sand dune soils including thermophilic species is also being investigated. Dr. G. J. F. Pugh is also studying the soil fungal flora, though his investigations refer to tidal mud flats before and during colonisation by glasswort *(Salicornia stricta)* and to later stages of the salt marsh. A study is also being made of micro-fungi developing on aerial stems of salt marsh plants.

Finally, the bacterial populations of the mud flats with particular reference to the factors governing their distribution, are being studied by Mrs. M. Turner and Mr. T. R. G. Gray.

All these studies of particular aspects of maritime vegetation in relation to its environment will provide data which should be of value in the use of plants for coastal protection and stabilisation.

M.C.P.

HIGHER DEGREE THESIS AND FIRST DEGREE DISSERTATIONS

Prepared in the Department of Geography

In the University, Geography may be read as a subject in the Faculties of Arts, Law and Social Sciences, and Pure Science. Since the award of the Charter to the University in 1948 all students taking an Honours degree in Geography have been required to submit a dissertation as part of their final examination. Only those dissertations and higher degree theses relating to East Midland subjects are listed below. *Bona fide* students or research workers may make application to consult them in the Department.

1958

Ph.D.

The railway as a factor in the location of manufacturing industry in the East Midlands. G. E. Bell.

1959

DISSERTATIONS

The Drone and Barlow Brook basins : a geographical study with particular reference to settlement and industry. A. W. Fox.

A geographical study of the agricultural landscape and economy of part of Northamptonshire (between Towcester and Weedon) considering the effects of wartime plough up. D. J. Frost.

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